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FINAL REPORT

on

A STUDY OF REQUIREMENTS FOR COMMERCIAL VESSEL SURVIVAL SYSTEMS

By

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The contents of this report reflect the views of Battelle Columbus Laboratories, Columbus, Ohio, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policy of the Coast Guard. This report does not constitute a standard, specification, or regulation.

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16. Abstract

This report presents results and recommendations of a study of survival-system requirements for commercial vessels. Data on commercial vessel classifications, commercial vessel trends, and life-saving equipment are presented. Summaries of casualty records pertinent to establishing needs for survival systems are included and analyzed. Survival-system requirements are expressed in terms of functions based on need.

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PREFACE

This report is a Final Report on a study of commercial vessel survival systems under Task Order No. 10, Contract No. DOT-CG-23223-A conducted during the time period from July 2, 1973, to February 20, 1975 The work was performed by the Columbus Laboratories of Battelle Memorial Institute under the auspices of the U. S. Coast Guard, with Mr. Ralph Buxton serving as program monitor. The principal investigator and task leader was Mr. Joseph V. Baum.

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for

UNITED STATES COAST GUARD
U.S. COAST GUARD HEADQUARTERS

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1.0 INTRODUCTION

1.1 General Background

This study was conducted in response to the recognition that there have been relatively few innovations in ship survival system applications in contrast to significant changes in ship construction and apparently significant changes in survival systems applied to other forms of transportation. The aims of this study are to enhance safety for personnel on board commercial vessels by a systematic approach. This is in consonance with other national safety programs to conserve and protect our human (as well as physical) resources.

Prior studies that were building blocks for this program include A Study of the Requirements for Survival on the Great Lakes,[1] An Analysis of Merchant Vessel Abandonment Procedures, [2] and, A Statistical Study on Ship Lifesaving Effectiveness[3]. The preceeding study on require-

ments for survival on the Great Lakes was used to develop procedures used during this study. Also, many of the results are applicable to the commercial vessels included in this study.

1.2 Scope and Purpose

The scope of this study includes the definition of functional requirements for survival systems on commercial vessels, the determination of the effectiveness of existing survival systems, and the identification of deficiencies of existing systems. Functional requirements are defined as statements of functions that are required to be performed by survival systems based on need and not limited by the capabilities of existing survival system equipment. The study was applied to commercial vessels subject to Coast Guard inspection including consideration of new vessel types which might be classed as inspected vessels. The study included consideration of uninspected vessels subject to Coast Guard cognizance. Pleasure craft and recreational boats were not included in this study.

The purpose of this study included the development of methodologies/analytical techniques and results for use in structuring future RDT&E program plans for commercial vessel survival systems and equipment and for evaluation of postulated improvements to survival systems.

1.3 Contents

This report includes a summary of the results, sections on methodology, vessel classes, vessel and survival system trends, casualty data, casualty data analysis, and casualty profile simulations. Results are presented on functional requirements and recommendations are presented. Appendices are provided for details on casualties and computations.

A computer program listing, Fortran program card deck, and a manual of instruction for the GERTS IIIC simulation program used in the analysis were transmitted on September 19, 1973. Also, an Interim Progress Report was transmitted on October 17, 1973.

2.0 SUMMARY OF PROGRAM AND RESULTS

A brief summary of the program effort and the results achieved are presented in this section. Additional details are presented in following sections.

2.1 Summary of Objectives

The objectives of this research effort were to study commercial vessel casualties from the viewpoint of personnel safety needs and develop functional requirements for survival system equipment and information on the effectiveness and deficiencies of current survival systems.

These objectives were achieved and in addition recommendations are presented for achieving improvements in survival systems. The methodology and techniques used in this program may also be useful in future U. S. Coast Guard research and development programs.

2.2 Methodology

The methodology used for this program consisted of three general steps:

(1) Collection and analysis of data
- Vessel classes and trends
- Survival equipment trends
- Casualty records

(2) Simulation of casualties
- Vessel abandonment associated with vessel casualties
- Falls from vessel into water

(3) Preparation of results
- Conclusions and recommendations
- Survival system functional requirements

The data collected and analyzed were mainly from U. S. Coast Guard sources, however, data on vessel and survival equipment trends were

obtained from other sources. Casualty simulations were performed using an available network analysis technique programmed for computer use. The program results were formulated considering data analysis and casualty simulation results. It was initially anticipated that the casualty simulations would be major determining factors in the formulation of the results, however, sufficient data were available that the data analysis results were dominant in the formulation of the results.

2.3 Data Collection

Data on vessel classes were obtained from U. S. Coast Guard publications on rules and regulations for the various vessel classes under consideration. For this study vessel classes were selected consistent with U. S. Coast Guard vessel classes but not detailed according to all subdivision criteria. Machine searches were made of NTIS and DDC files and copies of selected documents were ordered to obtain data on commercial vessel trends and survival system equipment trends. Open literature and other data sources were also searched for information on these subjects.

Data on casualty cases involving vessel abandonment and/or personnel deaths relating to the use of survival system equipment on commercial vessels were obtained from U. S. Coast Guard files maintained by the Information and Analysis Staff of the Office of Merchant Marine Safety. Casualty case files for Fiscal Years 1973, 1972, and 1971, were scanned and cases involving vessel abandonment and man overboard situations were selected for use in this study. Data summaries were prepared for the selected cases. The information sought for the summaries included casualty definition data, environmental data, and a brief narrative of events included personnel data. Approximately 780 summaries were prepared. Because of the relatively large numbers of cases involving fishing vessels and tugs, not all available cases involving these classes of vessels were summarized. Also, some case files of interest involving commercial vessels were not summarized when pertinent data were obviously missing (data on number of personnel involved, use of survival equipment, etc.). About 40 U. S. Coast Guard Marine Board of Review cases were also available and used. The dates of occurrance of these cases were between 1959 and 1971.

We believe that the vessel casualty and abandonment data base compiled represents more than three years of experience for major vessel casualty and abandonment situations and includes an adequate representation of abandonment cases for smaller vessels such as tugs and fishing vessels. Also, for the man overboard situation, we estimate that the data base includes about 72 percent of these types of cases reported in the selected three-year time period.

2.4 Data Analysis

A brief analysis was made of information contained in Statistical Summaries of Casualties perpared by the U. S. Coast Guard for Fiscal Years 1973, 1972, and 1971. Significant results of this analysis show yearly averages of:

- 184 deaths due to vessel casualties
- 114 drownings due to vessel casualties
- 111 deaths due to falls from vessel into water
- 104 drownings due to falls from vessel into water.

In addition it was determined that:

- About 65% of vessel casualty cases involve uninspected vessels
- About 73% of deaths involve uninspected vessels (It is important to note that there are significantly more uninspected vessels than inspected vessels in commercial service--on the average of four to one for vessels over 5 net tons)
- About 56% of vessel casualty cases are in daylight
- About 52% of deaths due to falls from vessel into water are in daylight
- About 77% of deaths due to vessel casualties are due to casualties when the vessel is underway
- About 71% of deaths due to falls from vessel into water occur when the vessel is underway.

Analyses of data obtained from the vessel casualty cases studied are summarized in tabular form. Considerably more detail is presented in other sections of this report broken down according to vessel classes and casualty types. At the onset of this program, it was anticipated that vessel casualties involving fires might reveal some differences in vessel abandonment events. The most significant differences found are in the numbers of persons lost prior to vessel abandonment, and the relative usage rate for life rafts. Table 1 is a summation of data analysis results for all vessel casualty and abandonment cases studied showing data summarized on a vessel casualty case basis. Personnel actions were not completely trackable for all these cases due to incomplete records.

Table 2 is a summation of data analysis results on vessel casualty cases studied that included cohesive data on personnel actions. The data analysis results shown in this tabulation were particularly useful in developing input data for the vessel casualty and abandonment simulations.

There are many significant items shown in these tables and in the more detailed data base from which the tables were derived. Data on vessel casualty situations are generally in agreement with data derived from the U. S. Coast Guard Statistical Summaries. In addition, it is concluded that:

- Persons successful in abandoning by use of group survival equipment or by direct transfer have a very high chance for survival
- Most of the persons abandoning and lost are persons who jumped into the water without floatation
- Except for tugs and barges, a relatively high percentage of vessel casualty and abandonment cases occur in ocean waters with the vessel underway
- Radio calls for help were reported for less than 1/3 of the cases studied. Also, for about 1/3 of the cases potential rescue vessels were on scene or nearby
- The chance of survival for persons jumping into the water for vessel abandonment situations is significantly higher than for personnel who fall from a vessel into the water

TABLE 1. ANALYSIS OF CASUALTY DATA FOR ALL CASES STUDIED
(DATA ON PERSONNEL EVENTS INCOMPLETE)

Vessel Casualty Case Events (Note: Data for all events were not generally available from each case studied)	Vessel Abandonment Cases Not Involving Fires	Vessel Abandonment Cases Involving Fires
Number of Casualty Cases Reviewed	365	82
Average Vessel Age (Years)	22.1	17.1
Percent Vessels Inspected	15.2	14.1
Percent Cases at Night (Not Day)	42.7	30.4
Percent Cases in Ocean Waters	83.5	67.9
Percent Cases at Dock or Tied Off	7.4	8.8
Percent Cases Radio Used to Call for Help	28.8	23.2
Percent Cases Lifeboat Launch Attempted	19.8	27.9
Percent Success Rate for Lifeboat Launch	77.4	88.2
Percent Cases Life Raft Launch Attempted	25.4	17.6
Percent Success Rate for Life Raft Launch	78.6	75.0
Percent Cases That Personnel Jumped Into Water	36.7	40.8
Percent Cases That Personnel Used Transfer or Other	43.2	40.8
Percent Cases That Personnel Remained on Board	5.0	12.8
Percent Cases That Rescue Vessel is On Scene or Near	32.0	32.9
Average Visibility (Miles)	6.85	8.1
Average Wind Velocity (Knots)	21.48	13.6
Average Wave Height (Feet)	6.11	3.3
Average Air Temperature (F)	58.11	63.4
Average Water Temperature (F)	54.84	61.3
Average Number of Personnel Abandoning per Case	7.4	13.0
Percent of Personnel Abandoning that are Saved	91.4	98.1
*Number of Persons on Board	2677	1349
*Number of Persons Abandoning	2366	1192

TABLE 1. (Continued)

Vessel Casualty Case Events (Note: Data for all events were not generally available from each case studied)	Vessel Abandonment Cases Not Involving Fires	Vessel Abandonment Cases Involving Fires
*Number of Persons Attempting Lifeboat Launch	368	225
*Number of Persons Successful in Lifeboat Launch	287	221
*Number of Persons Attempting Life Raft Launch	388	57
*Number of Persons Succeeding in Life Raft Launch	327	44
*Number of Persons Attempting Transfer or Other	1136	346
*Number of Persons Successful in Transfer or Other	1134	345
*Number of Persons Jumping Into Water	521	232
*Number of Persons Jumping With Floatation	325	151
*Number of Persons Jumping Without Floatation	158	81
*Number of Persons Saved From Lifeboat	230	536
*Number of Persons Saved From Life Rafts	381	47
*Number of Persons Saved From Water (With Floatation)	257	150
*Number of Persons Saved From Water (W/O Floatation)	74	60
*Number of Persons Remaining Aboard and Lost	128	162
*Number of Persons Abandoning and Lost	204	44
*Number of Persons Abandoning and Saved	2162	1170

* Data on numbers of persons involved were incomplete.

TABLE 2. ANALYSIS OF CASUALTY DATA SHOWING PERSONNEL EVENTS FOR CASES WITH DATA AVAILABLE

Personnel Events	Vessel Abandonment Cases Not Involving Fires	Vessel Abandonment Cases Involving Fires
Persons Attempting Abandonment by Lifeboat	203	81
Number Failing	45	0
Number Succeeding	158	81
Number Saved	197	81
Number Lost	6	0
Persons Attempting Abandonment by Life Raft	381	29
Number Failing	10	0
Number Succeeding	371	29
Number Saved	378	29
Number Lost	3	0
Persons Jumping Into Water	519	74
Number Jumping With Floatation	367	28
Number Saved	346	28
Number Lost	21	0
Number Jumping Without Floatation	126	45
Number Saved	86	37
Number Lost	40	8
Others Saved	25	1
Others Lost	1	0
Persons Using Transfer or Other Means	1943	140
Number Saved	1936	140
Number Lost	7	0

TABLE 2. (Continued)

Personnel Events	Vessel Abandonment Cases Not Involving Fires	Vessel Abandonment Cases Involving Fires
Total Number of Persons Abandoning	3046	324
Total Number Saved	2968	316
Total Number Lost	78	8

- The relative severity of the environment apparently has an adverse effect on the chance of personnel survival
- The average environmental conditions for all casualty cases appear rather mild and representative of average weather conditions expected. Worst case conditions reported were; wind-180 knots, waves-40 feet, air temperature-0 F, water temperature-32 F. Estimates were made of "severe" conditions not expected to be exceeded in 90% of casualty cases. These are:
  (1) Winds up to 56 knots
  (2) Waves up to 36 feet
  (3) Air temperature down to 30 F
  (4) Water temperature down to 34 F

Analysis of data obtained from casualty cases involving falls from vessel into water (man overboard) are summarized in Table 3. Some of the significant items shown in this table are:

- Relatively few persons were wearing floatation (life preservers)
- Very few persons were saved. It is suspected that additional persons may have been saved and casualty reports were not submitted
- The use of floatation appears to enhance the chance of survival
- Either the retrieval time must be reduced or the average time to drown must be increased to improve the chance of survival
- In about 30 percent of the cases, the person falling into the water was not seen and not discovered missing until later
- Environmental conditions are apparently an influencing factor on the chance of survival. Of those saved, only about 20% were saved when the winds and waves were worse than the calculated average values.

TABLE 3. ANALYSIS OF CASUALTY CASES INVOLVING FALLS FROM VESSEL INTO WATER

Events	Data For All Vessel Classes
Number of Persons in the Water	266
Number of Persons Saved	30
Number of Persons Lost	236
Number of Persons Wearing Floatation	25
Number of Persons Wearing Floatation and Saved	7
Number of Persons Seen to Fall	135
Number of Persons Seen in Water	136
Number of Persons Missing and Presumed Overboard	85
Number of Persons that Sank Immediately	22
Number of Cases that Floatation or Life Lines were Thrown	81
Number of Persons that Did Not Attempt to Reach Floatation	20
Number of Cases Involving Other Quick Rescue Attempts	93
Rescue Attempts Using Vessel (Relatively Long Time)	46
Rescue Attempts Using Vessels Small Craft (Lifeboats)	12
Rescue Attempts Using Other Vessels	49
Average Estimated Time to Drown (Minutes)	3.73
Average Estimated Time to Save (Minutes)	5.43
Percent Cases at Night (Not Day)	46.6
Percent Cases in Ocean (Not Inland)	58.9
Percent Cases Vessel Underway	51.1
Average Visibility (Miles)	7.86
Average Wind (Knots)	11.40
Average Wave Height (Feet)	3.30

TABLE 3. (Continued)

Events	Data For All Vessel Classes
Average Air Temperature (F)	57.75
Average Water Temperature (F)	57.16
Percent Cases Involving an Inspected Vessel	33.03
Average Vessel Age	17.71

- Worst case environmental conditions reported were; wind-55 knots, waves-40 feet, air temperature-10 F, and water temperature-30 F. Estimates were made of "severe" conditions not expected to be exceeded in 90% of the cases. These values are:
  (1) Winds up to about 27 knots
  (2) Waves up to about 10 feet
  (3) Air temperature down to about 32 F
  (4) Water temperature down to about 35 F.

2.5 Casualty Simulations

An available network analysis program, GERTS IIIC (Graphical Evaluation and Review Technique Simulation) was used to simulate casualty events and compare results considering hypothetical improvements in survival system equipment. Casualty profiles (activities and events) were formulated for vessel abandonment and man overboard situations. Inputs for the simulations from data analysis results were used to establish "baseline" cases representative of existing commercial vessel casualty experience. Hypothetical improvements in survival system equipment were then simulated.

Results of the vessel abandonment simulations are summarized in Table 4. Hypothetical improvements in survival system equipment were simulated and the results are shown in other sections of this report. The simulation of the hypothetical improvements were significant only to indicate that of the improvements considered (1) increased usage of group survival equipment, (2) increased usage of personal floatation, and (3) reduced time for rescue are likely to result in an increase in the percent saved. Because the percent saved is already high, the simulation results were not considered to be precise indicators of the relative extent of improvement expected.

TABLE 4. SUMMARY OF RESULTS OF CASUALTY PROFILE SIMULATIONS FOR VESSEL CASUALTY AND ABANDONMENT

Vessel Class	Percent Saved	
	Vessel Casualty (No Fire) And Abandonment	Vessel Fire and Abandonment
Large Fishing Vessels	91	95
Small Fishing Vessels	92	93
Passenger Vessels	96	99
Freight Vessels	92	97
Tankers and Barges	--	80
Tugs/Towboats	96	95
Platforms and Drilling Vessels	97	--
Miscellaneous Vessels	82	92

The results of the man overboard simulations are shown in Table 5. For the baseline case, representative of current experience on man overboard casualty events, the computerized network simulation provided an output of 12 percent of personnel saved. The hypothetical improvements that were investigated are listed with the resulting changes in the percentage of persons saved. The most promising types of improvements are (1) improved retrieval capability (simulated by hypothetical reductions in retrieval time and hypothetical increases in the percentages of persons retrieved on short term attempts), (2) increased usage of floatation, and (3) combinations such as improved communications (reduced percentage of persons not seen to fall overboard) and improved retrieval capability. It is interesting to note that simulation of improved thermal protection without increased use of floatation did not result in substantial improvements in the percentage saved.

2.6 Recommendations

There are three general areas for U. S. Coast Guard actions recommended from the results of this study:

- Promulgate procedures and develop equipment to reduce the occurrance and improve the survival rate for personnel who fall overboard
- Promulgate procedures and foster equipment developments to increase the successful usage of group survival equipment for vessel casualty situations
- Foster innovations in commercial vessel operations and equipment to achieve increased and faster response of potential rescue capabilities for vessels in distress.

There are many details associated with these general action areas that were recognized and included in other sections of this report. It is anticipated that it will be necessary to promote survival system equipment improvements for various problems to achieve the desired results of overall reductions in personnel losses from commercial vessels. Some more specific recommendations are briefly indicated here.

TABLE 5. SUMMARY OF RESULTS OF CASUALTY PROFILE SIMULATIONS FOR FALLS FROM VESSEL INTO WATER

Simulation	Results (Percent Saved)	Relative Increase Over Baseline
Baseline Case	12%	
Improved Communications and Resulting Reduced Retrieval Time	19%	58%
Improved Retrieval Capability	24%	100%
Improved Initial Alarm Method	17%	42%
Increased Usage of Floatation	20%	67%
Increased Thermal Protection (Without Increased Usage of Floatation)	16%	33%
Combination of Improved Communication Capability Plus Improved Retrieval Capability	30%	150%

The need for procedural and equipment improvements for man overboard situations is emphasized by the determination that the number of drownings reported due to this situation is almost equal to the number of drownings reported associated with vessel casualty situations. Specific actions recommended for meeting this need include:

- Establishing alerting systems to promote increased usage of floatation equipment
- Inspection of additional vessel classes to promote the usage of available equipment and foster survival system improvements for new vessels
- Develop improved equipment such as higher bulwarks, more effective safety rails, restraint systems feasible for deck activities in areas where railings are not practical, improved floatation and thermal protection equipment, better communication methods, and more rapid response retrieval capabilities.

The need for improved procedures and equipment developments to increase the successful usage of group survival equipment (lifeboats, life rafts, floats, etc.) is indicated because personnel who succeed in attaining survival status aboard group survival equipment have a relatively high chance of being saved (on the order of 98 to 99 percent). Specific actions recommended for meeting this need include:

- Promulgation of procedural innovations such as a personnel alerting procedure based on severe weather and/or adverse vessel conditions
- Provision of multi-modal means of vessel abandonment. This is particularly a needed consideration for new, high freeboard vessels with configuration constraints tending to centralize the location of group survival equipment. Casualty events such as fires may prevent accessability if only one mode of abandonment is provided.

- Promote innovations in equipment and/or vessel construction to improve egress from vessel to survival equipment. Examples include chutes, deployable ramps, and lowering systems compatible with group survival equipment.
- The consideration of the development of improved personal floatation equipment as a mode of abandonment functionally comparable with group survival equipment. This would also involve development of thermal protection, perhaps in combination with the improved floatation equipment.

The need for improved response of potential rescue capabilities is indicated by the apparently low usage rate of communication equipment in calling for help and the recognition that in approximately 1/3 of vessel casualty cases rescue vessels are on scene or nearby. Specific actions recommended for meeting this need include:

- Development of improved communication procedures such as a "buddy" system for use with "vessel alert" procedures.
- Development of communication equipment improvements such as systems that will operate independently of vessel power supply sources.

2.7 Functional Requirements

Summary listings of the functional requirements for commercial vessel survival systems are presented here. More details on the requirements and a discussion on needs is presented in another section of this report. It is recommended that action be taken by the U. S. Coast Guard to achieve more emphasis on survival system requirements as an integral part of ship design requirements. From review of casualty case records and particularly from review of data describing vessel trends, it is obvious that an adaptive approach is now common for considering the placement of survival system equipment on commercial vessels. Most descriptive accounts of new vessels do not include any mention of survival systems.

SUMMARY LISTING OF SURVIVAL SYSTEM FUNCTIONAL REQUIREMENTS FOR MAN OVERBOARD SITUATION.

Situation	Functions
Pre-abandonment functional requirements are to provide:	(1) Advance warning of potential need for use of survival-system equipment. (2) Accessability of equipment to user with minimum delay. (3) Alternative equipment capabilities compatible with vessel and environmental conditions. (4) Enhancement of chance of success of potential future functions (abandonment, survival, retrieval).
Abandonment functional requirements are to provide:	(1) Immediate notification of potential rescue capability. (2) Immediate availability of in-water capability. (3) Minimum physical hazard during fall into water.
Survival functional requirements are to provide:	(1) Floatation capability such that breathing capability is not disrupted. (2) Thermal protection compatible with water temperature and expected exposure time. (3) Communication for location identification. (4) Conservation of physical strength of survivor.
Retrieval functional requirements are to provide:	(1) Minimum time delay in accomplishing retrieval. (2) Compatibility of survivors equipment with retrieval capability. (3) Minimum demands on survivors' physical strength and dexterity. (4) Enhancement of self-retrieval capability.

SUMMARY LISTING OF SURVIVAL SYSTEM FUNCTIONAL REQUIREMENTS
FOR VESSEL CASUALTY SITUATIONS

SITUATIONS	FUNCTIONS
Pre-abandonment functional requirements are to provide:	(1) Advance warning of potential need for use of survival-system equipment. (2) Advance notification of potential need and confirmation as soon as possible of need for retrieval/rescue assitance. (3) Availability of alternative modes of abandonment and survival-system equipment in a stand-by status.
Abnandonment functional requirements are to provide:	(1) Communication to all vessel personnel of the decision to abandon ship. (2) Communication to potential retrieval/rescue capabilities of the status of personnel (vessel abandoned, location, etc.) (3) Immediate accessability of survival-system equipment for use by personnel. (4) Protection for personnel from environmental forces - wind, waves, cold temperatures. (5) Safe and expedient transport of personnel and survival equipment to the water.
Survival functional requirements are to provide:	(1) Personnel protection from the environment - thermal protection, physical protection, floatation. (2) Maneuverability capability for interim "rescue" of personnel in the water. (3) Communications to potential retrieval/rescue capabilites of the status and location of survivors.
Retrieval functional requirements are to provide:	(1) Continued physical protection of personnel during retrieval operation. (2) Compatibility of survival-system equipment with retrieval equipment. (3) Minimum demands on survivors' physical strengths for accomplishment of retrieval operation. (4) Enhancement of self-retrieval capabilities.

3.0 METHODOLOGY

To achieve the purposes of this study a systems analysis and simulation approach was used. The general method consisted of defining typical survival situations and identifying the functional needs arising from the situations. Three general steps were required for carrying out the method:

(1) Collection and analysis of pertinent data
(2) The formulation and manipulation of simulated survival situations
(3) The tabulation of results and formulation of conclusions and recommendations.

The data collection and analysis effort included data on vessel classifications and some consideration of vessel characteristics and trends that might be expected to influence survival. Also, data on survival systems and innovations in the design of survival equipment were considered. Casualty data and the analysis of casualty data provided much of the information used in the simulations. Fault trees were used to aid in quantifying survival system performance.

The formulation of survival situations was based on the analysis of casualty data. Only personnel survival situations that involved the use of survival equipment were of concern. Typical survival situations or casualty profiles were then described in a block-diagram network form of events and activities for shipboard personnel. A computerized network analysis program was then used to simulate the chain of events and to determine the relative effect of changes in survival-system capabilities on the probability of personnel rescue.

The results of the casualty data analyses and the simulations were used to formulate conclusions on the relative merits of postulated changes in survival system functional capabilities.

3.1 Data Collection

Several sources of data were used during this study. Machine searches were made of NTIS and DDC sources for information on commercial vessels and trends in vessel construction. Searches were also made for

data on survival systems and trends on design innovations in survival equipment. Open literature sources and the results of a recent patent search were also reviewed for data on survival equipment innovations. Coast Guard publications were reviewed for data on vessel classifications and survival system requirements. Coast Guard casualty files were reviewed to obtain data on casualty events. Some information on survival equipment was also obtained from these files. Copies of recent IMCO sub-committee reports were also obtained from Coast Guard sources. Some technical reports with data pertinent to survival problems were obtained from Battelle library sources.

3.2 Fault-Tree Analyses

Fault-tree analyses were used to aid in quantifying the probabilities of occurrence of various survival system failures for use in the casualty simulations. A fault-tree analyses consists generally of a logic diagram representing relationships among specific (usually system-oriented) events and an ultimate undesired (failure) event. System performance may be calculated using the logic diagram and probability values associated with the system events in the diagram. The application of the fault-tree method of analysis was limited by data availability. The construction of logic diagrams provided assistance in recognizing the functional needs of survival systems. A simplified diagram of the fault-tree analysis methodology is shown in Figure 1.

3.3 Casualty Simulations

A computerized network simulation program, GERTS IIIC (Graphical Evaluation Review Technique Simulation) was used to simulate the events of typical casualty profiles or situations. The GERTS IIIC program was developed as an extension of PERT programs (Program Evaluation Review Technique) and made available for use on this program by Dr. Alan B. Pritsker, Center for Large Scale Systems, Purdue University.

The GERTS network consists of nodes (events) and branches (activities). Nodes are either deterministic or probabilistic depending on the scheduling

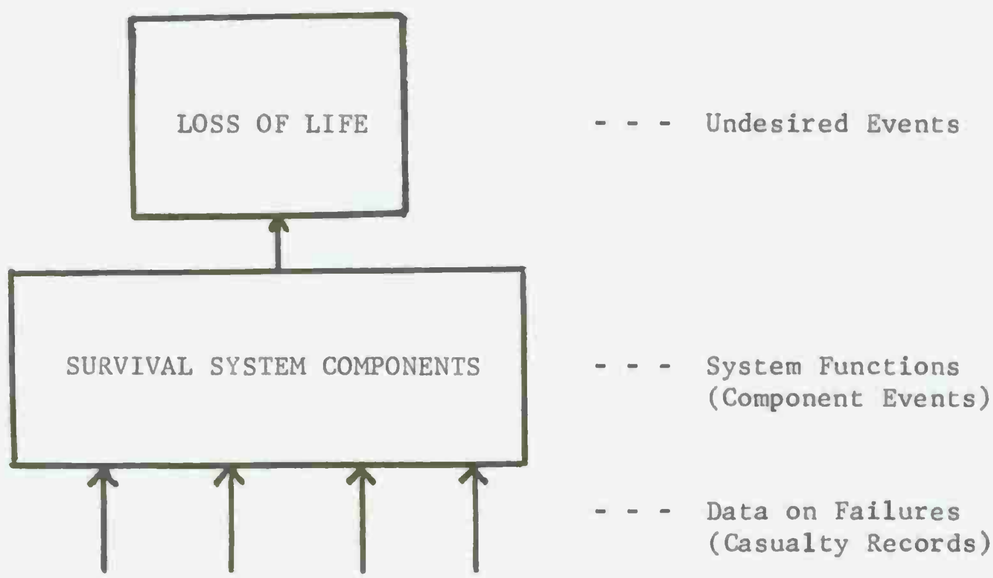


FIGURE 1. FAULT-TREE ANALYSIS METHODOLOGY

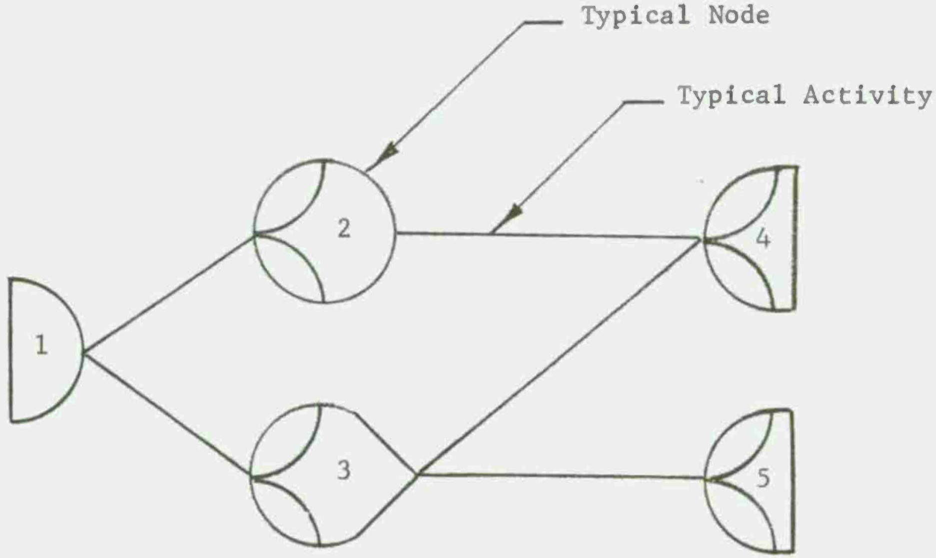
of activities emanating from them. Branches indicate activities characterized by the time required for completion. The simulation begins with one or more source nodes, proceeds from node-to-node by way of designated branches and ends with one or more sink nodes. Program replications provide for accomplishing the probabilistic node outputs using a Monte Carlo technique to establish branch times for each replication according to several possible distributions. On completion of a simulation (involving many replications) statistics are compiled on the proportions of nodes realized and the time (distribution) accumulated between selected nodes.

In general the program provides probabilistic calculations for a time sequence network of interconnected events and activities. By changing network values corresponding to changes in survival system capabilities, measures of the effects of postulated survival system improvements were made.

A diagram of a simplified GERTS network is shown in Figure 2.

3.4 Development of Functional Requirements

The development of functional requirements was a synthesis process considering at first casualty profiles (situations) representing events that were reported in casualty records. Then by making postulated changes in capabilities of survival systems guidance was obtained on the relative effect of the changes to evolve needed requirements for improvements. Because data are available on only part of the activities involved in survival events some needs were developed by considering special or isolated cases. The functional requirements developed were based on needs from the viewpoint of personnel on board the vessels. Search and Rescue requirements were not considered except as restraints on the casualty profiles. Also, the functional requirements were not tailored specifically to available life-saving equipment capabilities; however, state of the art functions of current and proposed life-saving equipment were used to guide the initial formulation of casualty profiles. The state-of-the-art capabilities of current survival systems used in the simulations were derived from Coast Guard casualty records. Figure 3 illustrates schematically the synthesis process used for developing the functional requirements.



NOTE:

Node 1 is a start node with deterministic outputs.

Node 2 is an intermediate node with a deterministic output.

Node 3 is an intermediate node with probabilistic outputs.

Nodes 4 and 5 are sink or end nodes.

Activities are shown as lines between nodes.

FIGURE 2. DIAGRAM OF A SIMPLIFIED GERTS NETWORK

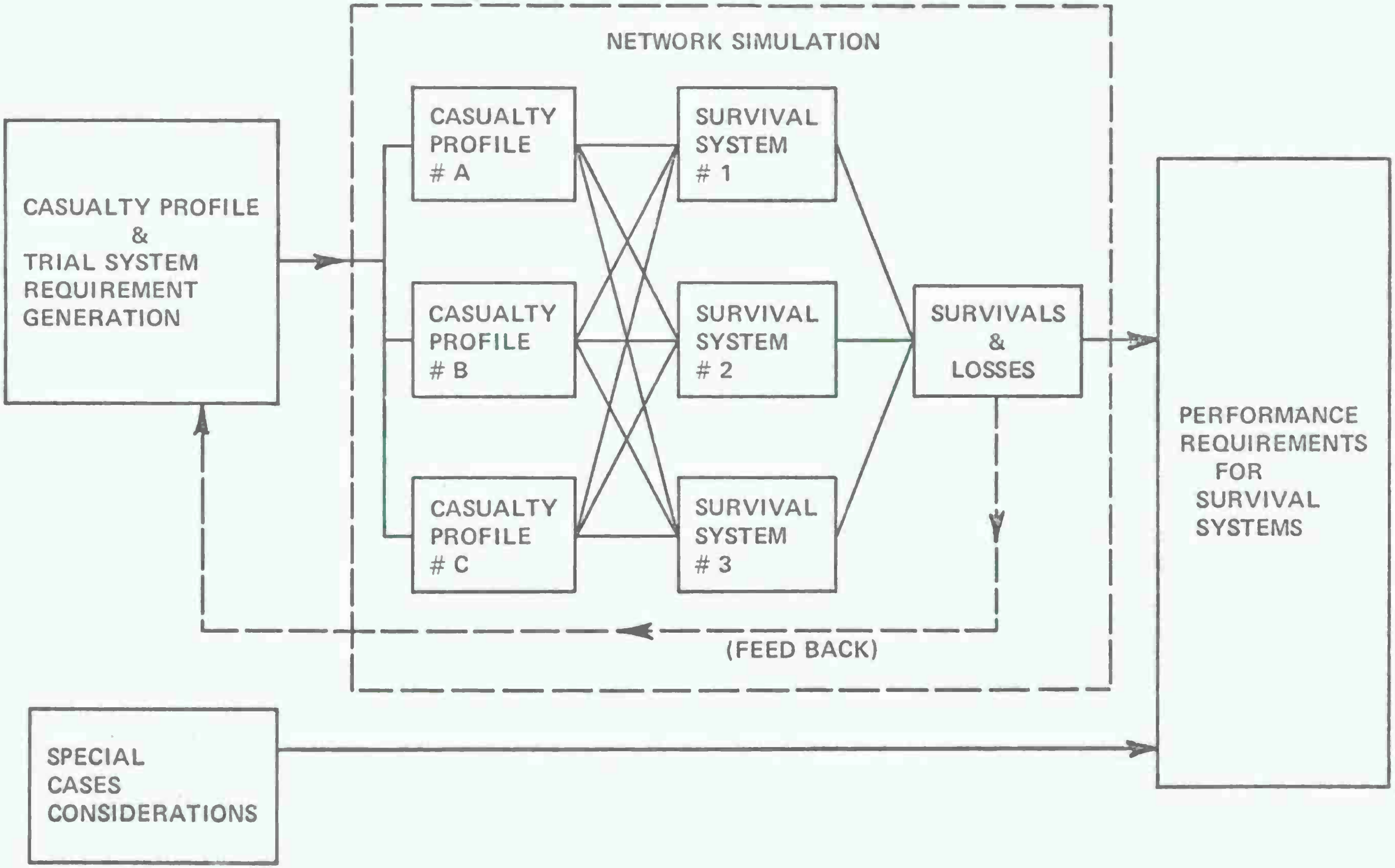


FIGURE 3. SYNTHESIS OF FUNCTIONAL REQUIREMENTS

4.0 COMMERCIAL VESSEL CLASSIFICATIONS

The functional requirements for survival systems on commercial vessels are expected to be responsive to vessel classes because of differences in potential usage of survival equipment. Also, the casualty data collected for use in this study is statistically summarized by the Coast Guard according to vessel classes.

The vessel classifications generally in use by the Coast Guard were reviewed and vessel classifications were selected that are anticipated to be responsive to survival system needs and not conflict with current Coast Guard classifications.

4.1 Classification Problem Discussion

There are several vessel parameters that appear significant to the alignment of survival system needs among commercial vessels. These include:

(1) Vessel function

(2) Propulsion method

(3) Vessel dimensions, such as length beam and freeboard

(4) Vessel configuration

(5) Location (routes of travel)

(6) Type of cargo

(7) Age of vessel.

There are also many common needs for all vessels associated with survival systems. These include availability of survival equipment to the persons on board, compatibility of communications with generally available rescue capabilities (the Coast Guard, other ships, and aircraft), and protection from a common adversary (the sea and adverse weather conditions).

Vessel classifications used by the Coast Guard start with inspection status (inspected or uninspected) continue by vessel types and then are subdivided extensively. For example, size classifications include tonnage criteria of 50, 100, 150, 300, 500, 600, 1000, 1600, 2500, and 3000 gross tons for determination of life saving equipment requirements.

For this study it was necessary to select vessel classes that are consistent with Coast Guard vessel classes but not detailed to the extent possible considerating all subdivision criteria.

4.2 Vessel Classes Used For This Study

The following vessel classes were used for this study:

(1) Passenger vessels of 100 gross tons or more

(2) Passenger vessels of less than 100 gross tons

(3) Freight vessels

(4) Tank vessels

(5) LNG vessels

(6) Barges, cargo and tank

(7) Fishing vessels, large, 50 gross tons or more

(8) Fishing vessels, small, less than 50 gross tons

(9) Tugs and towing vessels

(10) Offshore platforms and drilling vessels

(11) Miscellaneous, includes dredges, derrick barges, work boats, small service vessels, cannery tenders, etc.

These vessel classes were found to be compatible with the casualty data available and generally consistent with Coast Guard vessel classes. The inspection status was considered, when appropriate, within the above classes.

5.0 COMMERCIAL VESSEL TRENDS

Trends in commercial vessels that will affect survival systems are of interest for this study. Because the service life of commercial vessels is relatively long, (for example, the average age of U. S. Flag merchant type bulk carriers is 25 years) major changes in design and/or construction are not expected beyond those included in ships of recent design or are now in the building stage. There are, however, some recent innovations in ship design and some relatively long term trends that are

important considerations for survival system requirements. These are discussed according to selected ship classes.

5.1 Passenger Vessel Trends

The retirement of the "Queen Elizabeth" in 1968, marked the reversal of the superliner in trans-oceanic passenger trade. The recent poor economic performance of the Queen Elizabeth II and other large liners indicate that any future passenger vessels will be much smaller in size, and much fewer in numbers.

Trans-oceanic passenger traffic will continue to decline in a gradual way because of increased use of vessels in cruise trips, particularly on shorter cruises. Some around-the-world cruises and specialty cruises will continue.

Large Passenger Vessels

The large trans-oceanic passenger liner is now obsolete. The number of passengers carried by sea between North America and Europe in 1960 were 865,000 and in 1970 there were only 249,000. During this time passengers carried by airplanes increased from 1.76 million to 7.2 million. Recent studies in passenger traffic generally ignore the impact of trans-oceanic transportation. Therefore, for the purposes of this study, large passenger vessels can be ignored.

The typical passenger vessel for the future will be much smaller, and oriented for short cruises. The typical vessel will be from 625 to 825-feet long, about 90-feet wide with drafts between 27 and 29 feet. Most of these vessels will be under foreign flags and those of U. S. concern will operate from Atlantic ports on Caribbean cruises and other short cruises to Bermuda and the Bahama Islands. Passenger/ferry traffic between Seattle, VanCouver, and Alaska will also continue at current levels.

The principal concern of the U. S. Coast Guard with foreign flag vessels operating from U. S. ports in the cruise trades is the adequacy of survival equipment, qualifications of crews in abandonment procedures, communications, firefighting, and fire containment procedures.

An orderly abandonment operation with large numbers of tourists and passengers with very limited marine experience poses a difficult situation for any ships crew at best. To prevent panic and minimize the dangers for passengers in the event of fire or other serious accident at sea requires effective communications and survival training of crew and passengers. Any language barriers that may exist between foreign crews and passengers must be considered and minimized in the area of emergency procedures.

Contingency plans should also be developed for dealing with terrorist groups and other radicals that may commit acts of piracy. There have been two incidents of this nature in the recent past, and the marine transportation industry cannot remain complacent in light of the high frequency of such incidents experienced by airlines.

Combination Passenger/Cargo Vessels

As shown in recent ABS (American Bureau of Shipping) Annual Reports and other statistical summaries, the number of combination passenger/cargo vessels in the world fleet has been steadily declining. In 1960, there were 1254 and in 1970, there were 895 of these vessels. The size of the U. S. fleet of these combination vessels (13 or more passengers, 1000 gross tons and over) has also been declining. According to the 1962 edition of the Statistical Abstract of the United States [(4)], there were 309 combination vessels in the 1960 fleet (37 privately owned, 272 government owned). In 1970, there were 171 combination vessels (19 privately owned, 152 government owned) [(5)]. In another compilation for 1972, the number of combination vessels was further reduced to 13 privately owned and 35 MARAD vessels with the MARAD vessels shown in a Laid-Up condition [(6)]

Since the introduction and rapid growth of the foreign containership trade in the early 1960's, a marked decrease in the break-bulk cargo order book was experienced. Many U. S. ships in building and in service were altered for the container trade. This innovation has lead to a very small number of such vessels under U. S. flag and to the conclusion that this class is low on the priority list for survival system concern of the U. S. Coast Guard.

However, the economic pressure reducing this class in the U. S. fleet means that new ships will be few, and that vessels will remain in service longer, but mainly in trade routes including ports that cannot support the more efficient containership trade. Therefore, the U. S. Coast Guard must consider the consequences of aging ships, which will result in more drastic structural failures that may require abandonment in rough seas, and the likelihood of more frequent machinery plant failures. Plant breakdown could result in strandings with the possibilities of ships breaking up and requiring abandonment.

Small Passenger Vessels

No statistical data were found that could readily be applied on the number of small passenger vessels. There are, however, a significant number in use. For example, in 1968, there were 200 passenger vessels over 100 gross tons and 3671 small passenger vessels under 100 gross tons that were subject to inspection by the U. S. Coast Guard [7].

With trends toward increased offshore oil operations (oil rigs as well as tanker terminal activities) plus apparent continued use of small passenger vessels and passenger/ferry vessels, there appears a continuing need for consideration of survival system requirements for small passenger vessels.

One major concern of the Coast Guard is small ferry and tour boats where small crews have to contend with a high ratio of passengers with little or no marine experience. Further the short duration of trips do not present the opportunity for drills or instruction of passengers on emergency procedures. Even though the routes of such craft are usually in protected waters, large bays, and inter-island areas, the probability for sudden storm damage or capsizing is not negligible. In the case of passenger/vehicle ferry service, the probability of fire or sudden massive cargo shifting in a heavy weather could result flooding, capsizing, and panic in passengers. Therefore, the qualifications and training of crews in handling emergency situations is of the utmost importance in such vessels. The need to prevent panic and obtain the proper behavior of passengers for their own welfare in such situations calls for a high level

of qualification and stringent licensing requirements. Further, personnel survival gear must be simple, easy to don, and readily accessible. Abandonment procedures must also be simple and easy to implement.

The large number of crew boats used in the offshore oil and gas industry is a major concern of the Coast Guard. The intensive use of this large fleet at fairly high speeds (about 20 knots) coupled with a diverse range of marine experience of the crews should receive considerable study by the Coast Guard. These craft are typically 80 to 100 footers constructed of steel or aluminum. They are also used for carrying limited deck cargo as well as operating crews to the drilling and production platforms. This wide range of diversification in crew qualifications has resulted in special treatment of these craft in the licensing regulations enforced by the Coast Guard. However, for survival equipment and procedures these craft do not pose any great difficulties.

5.2 Cargo/Freight Vessel Trends

The general cargo ships recently constructed or now being built for American shipping are among the fastest and most efficient vessels in the world. Bolstered by the Merchant Marine Act of 1970, and the competitive position of our containership fleet, American operators are continuing to acquire and develop fast vessels with the latest cargo handling and navigation equipment. As of January, 1974, the new ships on order in U. S. shipyards number 87 *, the types of ships being built indicate the trend of American shipping needs. Most of these vessels are tankers, containerships, LNG tankers, LASH vessels, roll-on-roll-off ships, large bulk ships, large integrated barge tug ships, and combination oil/bulk vessels.

Notably absent are the conventional break-bulk cargo vessels; the other obvious trend is the building of large tankers (200,000 tonners) and a greater number of 35,000 ton "handy size" tankers. Another obvious trend is marked by the large number of LNG tankers in building.

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* Shipbuilding Progress Report, MAR-5100, U. S. Department of Commerce.

Break-Bulk Cargo Vessel

Because most general cargo moving between industralized nations with relatively balanced, two-way trade volumes will eventually be carried in container-type vessels, the role of the general cargo break-bulk vessel in international trade will gradually diminish. However, there are areas of the world today, such as Africa, South America, India and the Far East, that are relatively undeveloped in terms of harbors, industries, interconnecting roads and railroad systems. Cargoes destined to and from such areas must be packed or shipped in a form that can be adaptable to the cargo handling and transportation systems of the region. Therefore, traditional break-bulk general cargo ships will continue to be built for many years into the future to serve such areas, and to carry heavier and lower rated cargoes not sought by containership operators. For this reason, such vessels may have proportionately greater drafts relative to their size than containerships. The theme of the design and size of these ships will be "adaptability". In addition to accommodating break-bulk shipments and palletized cargoes, some will also be capable of carrying partial loads of containers, roll-on-roll-off cargoes, bulk grain and liquids, and other dry and refrigerated commodities, functioning as "multi-purpose" vessels, with dimensions oriented to the type of "pure" vessel that represents their prime function.

The average size of the break-bulk general cargo vessel being built today ranges between 12,000 to 15,000 deadweight tons, although a considerable number are still being built at 9,000 deadweight tons and less. The demand for much larger vessels would appear to diminish greatly after about 17,000 deadweight tons, with a few notable exceptions, such as the American Mail Lines newly-built "Alaskan Mail" class, which has a deadweight tonnage of 22,208. The dimensions of this class of ship, the largest of its type in the world to date, are length, 605 feet, width, 82 feet, and draft, 35 feet. This vessel may well represent close to the future size limit for break-bulk general cargo vessels. Although the trade route served by the "Alaskan Mail" takes in some of the major ports and terminals in the world, the ship is designed to compete for cargo movements

in many areas that are not yet experiencing growth in container transportation, or may not employ the most advanced cargo handling techniques or equipment *.

The small number of vessels in this class which is decreasing in number and in importance to American operators would indicate that these vessels should be low on priority in the Coast Guard study on survival gear. However, the long useful lifetime of such vessels, as evidenced by the average age of the existing fleet, indicate that the Coast Guard should direct particular attention to the seaworthy conditions of aging hulls and machinery plants rather than developing sea survival systems. Statistics on marine casualties show that the 18 to 22-year old vessels are highly prone to massive structural failures and frequent machinery breakdowns at sea.

Container Vessels

The development of containerization has been one of the major factors in strengthening the competitive position of the U. S. Merchant Fleet [8]. Container ships are more effective than general cargo ships because of more efficient cargo handling and the ease of transfer to and from other modes of land transport.

As in most transport areas, large size and high speeds lead to economic advantages as well as growth of transport vehicles. Therefore, the containerships now on order or in building are huge vessels, even though their deadweight tonnages are quite modest. As an example, take a 14,200-ton deadweight Atlantic Container Line ship, which has a volume capacity of about 2,000,000-cubic feet. This translates in terms of ship size into a 35,000-deadweight ton break-bulk general cargo ship **. Speeds of 20 to 33 knots are attained. Container capacities for ships recently delivered and on order are up to 2,000 slots for 20-foot containers. The Sea Land Galloway, for example, is designed for 33 knots, 27,600-deadweight tons, is 946-feet long, and can carry 896 thirty-five-foot containers and 200 fourty-foot containers.

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* Report on Merchant Vessel Size - The American Association of Port Authority, Committee on Ship Channels and Harbors, June, 1969.

** American Association of Port Authority, report of June, 1969.

Typical construction features for containerships include aft mounted propulsion machinery and wheelhouse, radar, automatic alarm systems for fire detection and some system malfunctions, Loran and RDF, direct-bridge control of main propulsion and side thrusters, steam turbine or diesel-power plants, and a variety of cargo-handling cranes (some are intended for roll-on, roll-off operation). These large ships have dimensions approaching 1,000-feet in length, beams of 105-feet, and drafts of 40-feet. While the size of containerships have grown rapidly in the past few years it is believed that this type vessel will not get much larger, and that the greater number of such vessels will remain in the 600 to 720-foot size, with speeds of about 25 knots. This constraint is the result of port, rail, and road limitations, and the long period of time required to amass sufficient containerized cargo to fill these huge ships.

These highly sophisticated ships have several design characteristics which make them different from cargo vessels of the past, i.e., fine lines and high speed. In addition, huge hatches and very little of the traditional main deck to provide the structural strength of the upper part of the hull exists in these ships. Deep longitudinal beam structures in the sides of the vessels provide strength in the top of the ship girder. The freeboard of these vessels plus the containers stacked above the main deck also provide huge areas subject to wind forces. In some of the earlier designs with limited freeboard, wave action and green water caused considerable damage to containers and cargo. Redesign of the bow structure and increased freeboard have contributed to drier weather decks, and less damage to containers in transit.

For survival considerations, the containerships, LASH (Lighter Aboard Ship) and SeaBee (Ship/Barge) vessels have much in common. These are all versions of the container trade. All the vessels are high-speed, fine-lined vessels with virtually no main deck contributing to the structural strength of the ships girder. All of these vessels have large areas (freeboard and weather deck loads) subject to wind forces. The main difference in profile and arrangements are that container vessels have bridge, machinery, and living spaces aft. The LASH and SeaBee vessels have their bridges and living spaces forward, and machinery spaces amidships.

All of these vessels present a high profile, i.e., high weather deck cargo, and bridge structure with very little clear space available on the main deck. Therefore, lifeboats, rafts, and other survival gear must be located at the extremities of the ships and two to three decks above the "maindeck level". There the abandonship equipment and procedures must account for high freeboard even in an undamaged condition. Ships of this size when down by the head or stern with or without list or heeling to either side can present formidable vertical distances survivors must traverse between ship and water. These facts plus abandonment in heavy seas plus the wind and current forcing a vessel to drift to leeward pose constraints on lifeboats, rafts, and/or escape capsules of various designs. Escape routes are more limited in vessels of this type because of the above, and require means for individual survivors to utilize chutes to transfer to the water and rafts or boats.

These vessels also require strict load management, especially with a partial load of empty and full containers to maintain a low center of gravity. Since most of the vessels in this trade are new or are recent conversions, we have little experience with these high speed ships. The U. S. Coast Guard must be concerned with the fatigue life of these new structural designs, which can be propelled at very high speeds for commercial freighters. Another concern is the reduced control that the mariner exerts on the type and security of a wide range of different cargos.

LASH/Sea Bee Vessels

Another relatively new type freighter is the LASH or Lighter-Aboard Ship vessel. This design is essentially an outgrowth of the containership. At this time ship barge systems are operated by 6 U. S. flag companies with 23 ships serving the Mideast, India, the Far East, and Europe. These vessels are typically:

	LASH	Sea Bee
Length	722 feet	873 feet
Beam	100 feet	105 feet
Draft	28 feet	32 feet
Deadweight	28,000 tons	39,000 tons
Power	32,000 at 22.5 knots	36,000 at 20 knots

The principal difference between these vessels and containerships is that the sophisticated and massive weight handling equipment is carried aboard ship rather than in the ports of call. LASH cranes of 500 ton capacity and the Sea Bees with 2000 ton submersible elevators are in use today.

The promise of these ships is in the rapid loading and unloading of shallow draft barges without the need for expensive port facilities. The barges can be marshalled using extensive canal and river systems serving large areas in feeding various ports. For them there is no need to enter congested harbor areas since these vessels can transfer cargo with little more than a protected mooring or anchorage. In ports with large volumes a barge/lighter fleeting or marshalling area will be required, but these need little in the way of capital investment or upkeep.

The survival considerations for these vessels were included in the section on containerships.

5.3 Tanker Vessel Trends

Tanker vessels for transporting oil are the largest ships now in use. The Globtik Tokyo, built in Japan, owned by Globtik Tankers Ltd., London, and chartered to Tokyo Tanker Company is the largest at this time, although larger ones are on order and in the planning stage. The Globtik Tokyo is 1,243 feet long, 203 feet beam, 118 feet depth, 476,000 deadweight tons, and is equipped with a 45,000 shp propulsion unit. (9)

As a result of the Merchant Marine Act of 1970, U. S. participation in the tanker and bulk cargo transportation field is expected to improve. Tankers ranging from about 35,000 deadweight tons to about 400,000 deadweight tons and Ore/Bulk/Oil (OBO) carriers of about 80,000 deadweight tons are planned or contemplated to provide a balanced U. S. fleet capability. Small or "handy sized" tankers (35,000 tons) will be built for short haul routes. Intermediate tankers will be used for moderate ocean routes and accommodated in most U. S. ports where draft limits up to about 45-feet exist. Very large (250,000 tons) and ultralarge (400,000 tons) crude carriers are intended for longer range ocean routes and limited ports.

The large number of tankers on order and in building for U. S. flag operators stress the growing importance of this type ship to the U. S. Coast Guard. The delivery of the Brooklyn, a 225,000 deadweight ton tanker in 1974, signaled a trend which can be appreciated by scanning a list of such ships in building in the U. S.

Number of Ships	Deadweight Tonnage/Ship
3	390,770
5	260,000
4	225,000
2	120,000
13	87,000 to 90,000
14	35,000 to 38,000
9	25,000
1	8,000

Design features that are significant for survival system considerations of the above ships of 90,000 tons and larger include generally aft located machinery and personnel accomodations, lengths up to 1,200 feet, beams up to 200 feet, drafts to 80 feet, and freeboards up to 32 feet loaded, 70 feet light. Trends for tankers are similar to trends for freighters in that increased use is expected of complex navigation and communication equipment and increased automation is expected for ship operation and cargo handling. For the ultralarge crude carriers with terminal locations planned offshore, crew traffic during loading and unloading is expected to be more complex.

The large number of intermediate and "handy-sized" tankers (25,000 to 35,000 tons) in building or sailing in the U. S. fleet require special considerations. Although these ships are of modest tonnage compared to other ships, these vessels are large and present similar problems to crews attempting to abandon ship with or without excessive trim or heel. The high freeboard coupled with explosive and combustible cargo place considerable stress on would-be survivors of a stricken ship.

Further, many of the handy-sized tankers are product carriers which may carry more than 20 different products. Some of these products

are highly volatile and explosive, others are highly toxic, therefore, the survivability systems and procedures must include the probability for such hazards.

LNG (Liquid Natural Gas) Tankers

One of the most competitive new areas in shipping and shipbuilding is the LNG carrier trade. Currently there are 44 large LNG tankers under construction in the shipyards of five countries. Sixteen of these sophisticated and expensive ships are in building at four American yards (Avondale, General Dynamics, Newport News, and Sun Ship). Fourteen of these ships will carry 125,000 cu.m. of LNG at -258 F and one atmosphere of pressure. The two being built at Sun Ship are slightly larger at 130,000 cu.m. capacity.

Since LNG is a lightweight liquid, about one-half the density of water, it requires ships of huge dimensions to carry modest deadweight. As an example, the 125,000 cu.m. ships above have a capacity of 60,000 tons, but it has the dimensions of a 150,000 deadweight ton oil tanker, note the particulars below:

Length at Waterline	- 892-912 feet
Beam	- 140.5-145 feet
Draft	- 36 feet
Freeboard	- 48 feet-58 feet
Power	- 39,000 to 42,500 shp
Speed	- 19.5 knots
Deadweight tonnage	- 60,000

Note the tremendous freeboard that these ships will expose to wind and wave forces.

The surprising thing in the LNG ship development is the rapid growth in size, and that no two tank, loading and transfer systems, are alike in design. Rather the competing designs have similar cargo handling systems, but there are significant technical differences in concepts for cargo containment. Because of the cryogenic nature of this highly volatile and explosive cargo, the containment vessels are a major cost element of these ships. There are many different containment systems but they all fall into two main categories, membrane and independent free-standing tanks with various geometries.

Survival equipment and procedure designs for these vessels must consider the extremely high freeboard (current designs 48.5 to 58 feet) the large length and beam, and of course, the peculiarity of the cargo, LNG at one atmosphere is at -260 F. It is odorless, extremely violent and explosive in a wide range of concentrations.

The cryogenic temperature of the liquid must be contained and insulated from the structure of the ship to avoid brittle failures in highly stressed structures. Any leakage of LNG on ordinary ship plate will lead to brittle failures. Most failures which have occurred to date have not led to massive structural failures, but very expensive repairs and design problems have been experienced with the Polar Alaska class of tanker. Other failures have been experienced from thermal and structural fatigue, caused by sloshing in partially filled prismatic tanks. Fortunately these failures occurred in the bow section where the bending stresses were low. How a massive failure in a containment system would impact on the crew and how one would design for providing adequate protection for them is beyond the scope of this study. However, one can visualize an almost instantaneous spillage of liquid, which would attempt to boil off violently and form a huge low lying cloud due to the low temperature of this light gas. Further, a temporary equilibrium would be set up between the LNG and the gas cloud, which would be affected by winds and other climatic conditions. The wide range of explosive concentration of this gas and the ability of such reactions to traverse back through the gas cloud certainly calls for special contingency plans as well as Research and Development for determining the behavior of large spills of LNG.

Nuclear Power

The recent oil embargo and the shortage of bunkering fuels in a number of ports have encouraged the proponents for nuclear power. These factors and the drastic increases in prices of fuels have caused a number of marine engineers to check their nuclear design cost figures again. Proponents have claimed that the power levels of the largest 33 knot containerships requiring 120,000 shp, huge submersible tankers, and a 414,000 ton surface tanker (contemplated by the Energy Corporation of America) would

provide economical test vehicles for nuclear power. However, the Maratime Administration recently announced that only one of four declared owners interested in investing in the huge tanker subsidy program submitted an application for a MarAd mortgage and loan guarantee. MarAd stated that the 414,000 ton nuclear powered tanker program has been shelved indefinitely. This is understandable since the difference in ship costs for nuclear over conventional power in this case is more than $60 million.

The low probability for nuclear powered merchant vessels in the forseeable future indicates that survival developments will not be affected by this power source.

Miscellaneous Vessels

The use of offshore drilling vessels and offshore platforms is expected to increase and to extend operations into deeper water. This trend is not expected to introduce significant changes in survival system implications.

Workboats and vessels that service the offshore oil industry are expected to become larger in size and more complex in construction. Typical vessel dimensions are expected up to 190 ft lg. and 1000 deadweight tons however gross tons would be under 300. This trend may result in the need for improvements in survival system requirements for these vessels.[12]

5.4 Barges, Tugs, and Miscellaneous Vessel Trends

The integrated Tug-Barge concept is the main area of innovation for tugs and barges that appear likely to have any impact on ocean shipping. In this concept, the tug vessel is designed to be physically attached to the barge so both respond as one ship during transport. Then, at the terminal, the tug can be detached from one barge and attached to another for a return trip [8]. The incentives to build huge integrated tug/barge units are based on the lower standards of specifications for building barges. However, the massive structural failure of the Barge Ingram indicates the careful study of the structural adequacy of these huge barge/tug designs. Increased growth in size and numbers is expected. Ingram Tech., Inc., has applied for construction subsidies for six 80,000 deadweight tons tug/barge units.

Most tug-propelled barge operations have been on interior waterways. The Tug-Barge combination appears suitable for coastal and ocean traffic and also appears to have an economical advantage over conventional ships. An example of a new integrated tug-barge is the 975 feet long, 52,000 dwt, 104 feet wide, by 46 feet depth barge under construction for use on the Great Lakes. The barge will be pushed by a 152-foot tug. There are no new features that appear to be significant to survival system needs except that as the Barge-Tug system size increases more personnel may be required for operation and perhaps personnel may be regularly stationed on the barge during transport. If so, survival equipment will be needed on the barge.

Trends in tug vessel design and usage do not appear to indicate any significant changes except for the integrated tug-barge system. Because the number of tugs involved in vessel casualties are relatively high (for fiscal 1972, there were 1,080 tug vessels involved in casualties compared with a total number of 4,117 vessels), tug vessel casualties are an important area of concern for survival system considerations.

5.5 Fishing Vessel Trends

Forecasts of trends for U.S. fishing vessels are mixed. According to one reference[13] there were approximately 77,000 commercial fishing craft in 1960, an expected increase to 85,000 vessels in 1970, and an expected decrease to 83,000 in 1980. The average number of fishermen per craft is expected to decline from 1.69 to 1.61 to 1.59 for corresponding dates. The yield or fish harvest in recent years has been declining (in 1962 the yield was about 5.3 billion pounds down to 4.1 billion pounds in 1968). The forecasts for the number of Search and Rescue Cases by the U.S. Coast Guard for fishing craft are 3,450 for 1970 and 3,220 for 1980.

Based on the Annual Statistics of Casualties published by the U.S. Coast Guard there were 728 vessel casualties, 63 deaths, and 9 injuries for fishing vessels. Because these are a substantial proportion of the corresponding totals (3,108 vessel casualties, 131 deaths, and 74 injuries) it is concluded that survival-system requirements for fishing vessels are an important area of concern regardless of forecasts for fishing vessel activities. Also, no major changes in fishing-vessel configurations are anticipated in the near future that would strongly influence survival-system requirements. The general trend is mixed, more larger fishing vessels offset by more smaller vessels and fewer intermediate sizes.

6.0 SURVIVAL-SYSTEM EQUIPMENT TRENDS

Data on equipment for survival systems were sought from several sources, including open literature publications, DDC and NTIS Data Banks, personal files of U.S. Coast Guard and Battelle personnel. Letters of inquiry were drafted and sent to approximately 40 potential suppliers of marine survival equipment requesting information on their latest products. Included in this section are:

- Synopses of manufacturer's claims for typical equipment from advertisements that may indicate design trends
- Abstracts of responses from potential suppliers showing their latest developments in life saving and survival equipment and their claims on performance
- A summary of significant reports from NTIS AND DDC on new developments in life-saving equipment
- Pertinent information from the proceedings of the sixth session of the Sub-Committee on Life-Saving Appliances of Inter-Governmental Maritime Consultative Organization for new developments in life-saving equipment.

Bibliographis from DDC and NTIS reports on survival equipment have been reviewed and selected brief summaries are shown in Appendix C. No attempt was made to substantiate or refute manufacturer's claims on performance.

6.1 Life Boats

Inflatable lifeboats are made by several companies including UK Concessionaries; RFD-GQ Company; Rubber Fabricators, Incorporated; and the Avon Rubber Company. These boats are all of the same general design: an inflatable tube down each side of the boat, a wood supported bottom, and a wooden stern for attaching an outboard motor. The boats are made in sizes from 7 to 19-feet long and are capable of carrying 2 to 8 people. Advantages of these boats over inflatable rafts are their stability and maneuverability.

Water Craft Limited has developed a completely enclosed fiber glass lifeboat that is self-launching and self-righting. Its diesel

engine will drive it at a sustained speed of 6 knots for 24 hours. The craft contains a compressed air pump that will spray water over the outside and pressurize the crew area with its exhaust for 8 minutes while traveling through fire-covered seas. This boat can hold 50 people while being controlled by one man.

The Carroll Engineering Company is a major producer of lifeboats. They make both metallic and fiber glass reinforced plastic boats, which can be either oar propelled, hand propelled, or motor propelled. The boats are 15-30 feet long with a carrying capacity of 10-75 people.

Lane Marine Technology manufacturers galvanized steel lifeboats. These come in sizes from 14 to 28 feet and are epoxy coated. Each boat contains foam floatation, food, water, fuel tanks, stretchers, and a motor.

The Whittaker Corporation's Brucker Survival Capsule is made of bright orange fiber glass and is shaped like a covered dish. It is 13-1/2 feet in diameter and is 9-feet high. It will protect 28 men against fire, explosion, suffocation, swamping, exposure, and starvation. It is propelled by a 40 hp diesel engine and, with its new underwater stabilizer, is stable in heavy seas at a speed of 5 knots. It can be lowered without power at 2 ft/s by a single line.

6.2 Life Rafts

The "floating igloo", manufactured by the Walter Tanger Company, is a rigid life raft that requires no yearly service to maintain it. Buoyancy is provided by the use of closed-cell plastic foam so the craft is unsinkable and lands right-side up in the water. The "floating igloo" is a small, covered raft.

An insulated one-man life raft was developed by the Navy to protect downed pilots. It is inflated by a 1/2 pound CO_2 cartridge. The floor and canopy are orally inflated with a clear, plastic viewing port in the canopy. The raft is equipped with a sea anchor and the canopy can be made watertight by velcro strips around the "y" shaped entrance.[14]

Inflatable life rafts are manufactured in several styles by the RFD-GQ Company; Rubber Fabricators, Incorporated; Switlik Parachute Company, Incorporated; and the Avon Rubber Company. These rafts are made of rubber and canvas, and all are covered for protection against the weather. Sizes range from 4 to 25-man capacity. The RFD model can be launched using davits, and all automatically inflate upon submersion. While in storage, the rafts are packed in a water tight plastic case. These rafts are usually inflated by CO_2 cylinders and vary from 10 to 40 seconds development time. Emergency survival kits are included as an option or standard equipment with each raft.

A special type of life raft, made by Plasti-Kraft Corporation, is a molded float ring covered with fiber glass and attached to a nylon net slung below it. These light-weight rafts (60 pounds for the 12-man capacity) are capable of carrying 6 to 12 persons and will continue to float even if punctured. They provide very little weather protection, however, and could cause some stowage problems.

A life raft similar to the Plasti-Kraft model is made by Atlantic-Pacific Manufacturing Corporation. They make a larger size with a capacity of 25 people.

A one-man life raft developed by NASA has a unique entrance mechanism - a zippered bottom. To enter, the man swims under the raft or lifts one side out of the water, unzips the slot, slides in, and rezips.(15)

6.3 Personal Floatation Equipment

LIFEGARD's Aqua/Matic Model 10 is a self-inflating vest that inflates upon immersion in water. It is self-righting and intended to hold the head back. It won't inflate in spray or rain and reduces the shock of falling usually present with a device that is buoyant before entering the water. It has a manual override on the inflation device. The system is rechargeable and requires no special training for service or operation.

The Gentex "Comfort King II" is a solid-covered foam device that can be used for both a work vest or floatation vest. It is durable and adjustable while affording maximum spinal protection. Reflective patches are available for the vest.

The RFD-GQ Limited Company (England) has an inflatable life jacket which is inflated by using a toggle-operated CO_2 cylinder that inflates the device to 38 pounds of buoyancy. It is a good working jacket because of its compact size before inflating.

The Hart Imco life jacket is another solid-covered foam device made of shock-absorbent polyurethane foam. It has a flexible cover made of orange nylon. The jacket is rotproof, fire retardent, and folds easily for compact storage.

The "Perky Buoy" by R. Perry and Company is a rigid non-flammable ring buoy. It has a PVC skin and rope loops for safety lines. It comes in orange, white, or red and white quarters.

Atlantic-Pacific Manufacturing Corporation produces two types of preservers, a foam-filled and a kapok-filled type. Each of these is in the vest style and must be strapped on. Also available are life belts, life rings, and "horseshoe" life buoys.

Gentex Corporation developed a foam known as polyvinyl chloride brand name "Genucel", which is rotproof, mildew proof, and self-extinguishing. They make life vests, life belts, work vests, and ring buoys with this foam.

Inflatable life vests are available from Engineered Systems Company, Division of B.F. Goodrich, Company. These are CO_2 inflated or they can be blown up by the user. They are compact and easy to wear until needed.

An Army life preserver has been developed using oral inflation and fitting under the wearer's arms causing him to be in a vertical position at all times. This preserver must be unfolded and inflated before entering the water.[16] An improved model of this life preserver has been developed using a CO_2 inflation device that can be automatically or manually inflated.[17]

An infant floatation device was developed by the Civil Aeromedical Institute. It has a neoprene insultated lower bag and an inflatable

top. The device can be inflated by CO_2 canisters or orally. It is weighted to remain upright and is covered by a weatherproof hood. With the movement of the waves the hood moves up and down producing a pumping action thereby providing ventilation.[18]

6.4 Descent Systems

B.F. Goodrich has applied their quick-escape slides developed for aircraft to ocean vessels. These are inflated by a nitrogen and air mixture contained at 2000 psi. The system can inflate in 15 seconds and remove 30 crew members in less than a minute. The slides are designed for up to 65 feet of freeboard. At the end of the slide is a detachable-inflatable raft.

The C-5 descent device is a one-man lowering device designed for use on the C-5A aircraft. It contains a steel strip attached to an inertial brake. The brake consists of a fixed drum with 4 shoes that are inertially forced apart and against the drum as the steel strip is pulled out. The device is held by a handle with the other end of the steel strip attached to the vehicle. As the man jumps and falls, the brake slows his descent rate to 18 ft/sec. The device weighs 2.4 pounds and has a 40-foot steel strip.

The Atlas Safety Equipment Company, Incorporated, has developed a controllable descent device for people working in high places that could be used for large-ship evacuation. It consists of a sling attached to a sliding mechanism on a nylon-covered stainless-steel rope. The sliding device crimps the rope to control the descent speed. The slide is self-locking so that it stops automatically when released.

Rescumatic Division of Research and Trading Corporation has an automatic rope lowering device called "Rescumatic Sea Descent Gear Mark II." It lowers people from 20 to 300 pounds at a constant rate of 6 ft/sec. from heights of 150 ft. It contains a spring loaded automatic return and a lanyard-controlled brake for complete stopping while descending.

6.5 Other Survival Equipment

A life buoy marker called "Manoverboard" has been developed by Pains-Wessex Company. This device provides 2 lights each with 2 candle power for 45 minutes and orange smoke for 15 minutes. It is used with automatic release buoys and is activated as the buoy drops in the water. It is safe to use in oil or gas-covered water.

A search initiator buoy called "lifeline" has been developed by Intercontinental Marine Ltd. It comes in four sizes, depending on the size ship it is installed upon, and as the ship sinks it is released to float to the top still connected by rope to the ship. On the surface, the buoy automatically begins sending emergency radio signals, flashing a strobe light, and deploying inflatable life rafts and other life-saving equipment. It pinpoints the location of boat and survivors immediately and provides a point for the rafts to tie up into the weather.

The Schermully Company "Speedline" is a molded-plastic line thrower. It fires a 10-pound-firing weight up to 250 yards. It has a cylindrical shape 13-inches long and 7.5 inches in diameter. A 41-mm international rocket is used.

A new hand-held searchlight by Specialty Lighting has 180,000 candle power and provides good illumination at 1/2 mile or more. It is called the "Model 2160" and is designed for short-term emergency use.

The "Resuscimask" is a portable resuscitator used extensively by hospitals and medical men. It is simple to operate and has a special suction to remove blockages. It comes with a standard and small (children's size) mouthpiece.

International Marine's "Solas III", a portable survivor radio, weighs less than 14 kg (31 pounds). Its plastic covering makes it tough enough to withstand a drop 30 feet into water. It operates on three emergency bands with voice transmission and reception on two of these. It is powered by either a 24-volt battery or hand generator.

The "Sarbe BE-369" is a floatation distress beacon developed by Burndept Electronics. It is lightweight, self-righting, and broadcasts on both the military and civilian distress frequencies for 48 hours.

The Billy Pugh "Personnel Net" is a safe transfer device. It is collapsible and requires little storage space. It can provide easy access to men in the water and quick transfer from one ship to another.

The "Signal, Underwater Sound, (SUS) MK. 59, Mod. 5" is an explosive device developed to cause a high-energy underwater sound which can be detected and located by electronic means. These devices are completely safe and can be adjusted to fire at depths from 1600 to 6000 feet. They can be dropped by occupants of a life raft intermittently to help rescuers find their position. It was developed by Bermite Division of Whittaker Corporation. [19]

The SM-1 Illumination Marker, by Chromalloy Electronics, is a flashing beacon marker light. It uses a 1.5-volt battery for 80 hours of continuous flashing. It is shock-proof and water-proof, and has an automatic switch that turns on whenever the device is in an upright position. It floats with its light 8 inches out of the water in all kinds of seas.

The Chromalloy RLB-6 Transmitter is a distress beacon attachable to the sides of a life raft. It has two antennas so that if the life raft is tipped over it will still be able to transmit. It can either be actuated by the raft deployment or by water immersion. The operation life is 48 hours at all temperatures using lithium batteries.

Inland Marine Company sells a variety of flexible tanks made of rubberized-nylon fabric. These tanks can hold water, sewage, and fuel and can fit in any available space. These tanks would be convenient in the cramped quarters of a lifeboat. The tanks come in 11, 20, 33, or 44 gallon sizes.

All types of emergency lighting and electrical equipment are available from the L. L. Rowe Company and Teledyne Big Beam. These include lights to penetrate smoke and help people escape through fires. These are battery-operated emergency lights, and hand-held lights.

A davit designed especially for lowering life rafts is being manufactured by Marine Safety Equipment Corporation in conjunction with an inflatable life raft made by Engineered Systems Company, Division of B.F. Goodrich Company. The davit supports the raft by one point through the top of the raft cover

while inflating. The people can then enter the raft by stepping into it directly from the deck of the ship instead of entering the water first.

Resolution Engineering Development Company (REDCO) has developed the "Red Adair Escape Boom". Designed especially for offshore-drilling rigs, these booms provide a place of refuge away from the rig in case of fire or explosion. One end of the boom is attached to the rig and the other end to a floating or counter-balanced platform. The men on the rig reach this platform by walking down the boom itself or by using escape lines.

The Welin Davit and Boat Division of Continental Copper and Steel Industries, Incorporated has a wide selection of davits and winches for lowering lifeboats. Size, strength, position, and activation mechanism are all dependent upon the specific needs of the particular vessel. Carroll Engineering Company also makes a long line of davits and winches, along with facilities for producing any special types needed.

Sav-A-Life Rescue Ball is a throwable life preserver. It is the size of a baseball until immersed in water where it inflates into a 21-inch life ring. The Coast Guard tested this device and found that due to inadequate protection prior to use, it may inflate before it could be thrown.[20]

Manhattan Marine sells a man-overboard locating device called "Mayday". Deployment is by a small tin can that attaches to a belt or life preserver. The user pulls the lid off when in distress and a water-activated chemical inflates a bright red ballon. The ballon is tethered by a 100-foot line and will remain aloft for several days in all types of weather.

A solar still is also available from Manhattan Marine. It can be attached to a life raft, filled with seawater, and will provide adequate water for one man with sufficient sunshine.

The Navy made a study of effective means of evacuating men from burning ships. Reflective markers were mounted on the passageway walls and used to guide the men from the stricken ship. The men used sealed-beam U.S. Navy hand lanterns to illuminate the markers.[10]

6.6 IMCO Proceedings

An Amendment to the 1960 Safety Convention was approved by the Maritime Safety Committee requiring all inflatable life rafts to be drop tested from a height of 18 meters.

The priorities of the Sub-Committee on life-saving appliances was revised to include considerations on the survival-craft hull material and its ability to be atmospherically self-supporting for use on tankers, gas-carriers, chemical-carriers, and combination carriers.

The delegation of the Federal Republic of Germany to the Sub-Committee showed a film of a self-bailing life boat. They are considering making these boats mandatory in certain cases.

A twin-tube inflatable boat concept was discussed. Denmark and Germany had approved these boats for use as life boats in vessels under 500 tons and were considering them for larger vessels.

7.0 CASUALTY DATA

The casualty data used for this study included commercial vessel casualties reportable to the U.S. Coast Guard and available from files at U.S. Coast Guard Headquarters, Washington, D.C. Casualties from recreational boating were not included. Also, because a prior study was made of survival-system requirements for the Great Lakes, casualty accounts specifically related to the Great Lakes were generally excluded from consideration. Statistical summaries of commercial vessel casualties prepared by the U.S. Coast Guard include data from the Great Lakes.

7.1 Casualty Definitions

Casualties involving commerical vessels are required to be reported to the U.S. Coast Guard whenever the casualty results in the following:

(1) Actual physical damage to property in excess of $1500
(2) Material damage affecting the seaworthiness or efficiency of a vessel
(3) Stranding or grounding
(4) Loss of life
(5) Injury causing any person to remain incapacitated for a period in excess of 72 hours; except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty.

Only those casualties within the above definitions that involved the use of survival systems were of interest for this study. Exemptions are personnel injuries sustained by crewmen while working aboard ship (and not resulting in falls from the ship into the water) and natural deaths or incapacitations as a result of illness or disease. Suicides were generally excluded from consideration; however, the statistical summaries may include some suicides. Also, some cases involving falls

from vessels into the water may have been the result of suicide attempts, although difficulties were encountered in classifying these suspected suicide attempts.

Casualties involving fires were considered without precisely including fire-fighting equipment as a part of a survival system.

7.2 Source and Extent of Casualty Data Used

All casualty data were obtained from the U.S. Coast Guard in the Casualty Review Branch of the Office of Merchant Marine Safety. Copies of Statistical Summaries of Casualties to Commercial Vessels were obtained from the Information and Analysis Staff of the Office of Merchant Marine Safety. Also, computer printouts were obtained from the Information and Analysis Staff to aid in reviewing the casualty data files.

Casualty case files for fiscal years 1973, 1972, and 1971 were studied. There were approximately 8000 vessel casualty cases and 5000 death and injury cases in the files. The procedure used included a scanning and selection activity to identify those cases involving vessel casualties in which survival systems were used or should have been used, and personnel deaths and injuries associated with vessel casualties or personnel in the water.

Brief summaries were then prepared of the selected cases. The data sought included:

(1) Casualty identification information

(2) Vessel description

(3) Weather conditions

(4) Sea conditions

(5) Location

(6) A brief narrative of events including circumstances prior to the casualty, survival related times for events, abandonment and retrieval events, and numbers of persons involved.

A total of approximately 780 summaries were prepared. These included approximately 30 cases involving vessel fires without abandonment that were reviewed for information on pre-abandonment activities relative to vessel fire type casualties only. Because of the relatively large numbers of casualties involving fishing vessels and tugs, not all cases involving these types of vessels were summarized, particularly cases with limited information relative to survival system usage. Also, because of the large number of cases on file, no attempt was made to sequentially account for all cases. Very few personnel injury cases were found pertinent to this study. In addition to the casualty case file records, approximately 40 casualties were reviewed and data were extracted from casualty accounts that were available from U. S. Coast Guard Marine Boatd of Investigation reports. The Marine Board case reports were not limited to fiscal years 1973, 1972, and 1971.

Because the casualty report forms and other information included in the files are not mainly directed toward providing data for establishing survival requirements, many case files provided very limited information on the parameters of interest for this study. Thus, it was necessary to review a large number of cases in order to obtain data. To minimize the volume of this report, representative summaries of the casualty cases used in this study are shown in Appendix A according to vessel classes. The numbers of cases for each class are not proportional to the available numbers of cases. Casualty cases involving fishing vessels and tugs were much more numerous than those involving other types of vessels.

8.0 CASUALTY DATA ANALYSIS

Statistical summaries of casualty data available from Coast Guard sources were briefly analyzed to obtain general information on casualties. These data were mainly useful to indicate on an overall basis the relative frequencies of personnel losses associated with casualty types and vessel classes.

Data extracted from casualty records were analyzed to obtain more specific information on casualty events and the functions performed by survival system equipment. As previously indicated, approximately 13,000 casualty case files were scanned. Data were extracted from about 780 cases. These were cases involving the use of survival equipment and containing at least some information on casualty events and survival system usage that could be quantified for analysis. Unfortunately, many casualty case records did not contain specific information needed for analysis.

8.1 Data Developed From Statistical Summaries

Tables 6, 7, and 8 are compilations of information relating to selected events derived from U. S. Coast Guard Statistical summaries. From these tables, some factors were derived that indicate the probability of occurrence of various events. Table 9 shows a listing of these factors and the conditions for occurrence. Not all events listed are directly pertinent to considerations on survival-system requirements. Some indicate areas of priority for survival-system improvements.

There are some apparent abnormalities in the data. For example, there are listed an average of three drownings due to vessel fires. These are taken to be the result of crew memebers jumping into the water (not falls from vessel) and subsequently drowning. Also, the difference between the categories of "drownings - no vessel casualty - due to falls from vessel into water", and "deaths - no vessel casualty - due to falls from vessel into water" are taken into account for cases when the falling person strikes an obstruction or the dock and the assigned cause of death was due to physical injuries.

The numbers of deaths assigned due to suicides are on the average, 15 per year, and approximately 9 of the suicides are by drowning. Some of the deaths attributed to "falls from vessel into water" may also have been suicides; however, for the purposes of this program no attempt was made at reclassification.

TABLE 6. DATA FROM ANNUAL STATISTICS OF CASUALTIES
(Fiscal years 1973, 1972, and 1971)

Fiscal Year	Number of vessel casualties	Number of vessel casualties due to fires (all types)	Number of vessel casualties due to collisions (all types)	Number of vessel casualties due to founderings, capsizings, and floodings	Drownings due to vessel casualty	Drownings due to vessel casualty - fires (all types)	Drownings due to vessel casualty - collisions (all types)	Drownings due to a vessel casualty - founderings, capsizings and floodings	Drownings - no vessel casualty	Drownings - no vessel casualty - due to falls from vessel into water	Injuries - no vessel casualty - due to falls from vessel into water	Numbers of vessels totally lost
1973	3108	147	1264	140	76	0	20	28	119	99	10	321
1972	2424	160	1085	85	103	5	30	21	115	93	12	309
1971	2577	176	1119	92	164	5	51	41	134	121	12	366
Avg. for 3 years	2703	161	1156	106	114	3	34	30	123	104	11	332

TABLE 7. CASUALTY DATA BY VESSEL TYPES
(Average values for fiscal years
1973, 1972, and 1971)

	Total Number of Vessel Casualties	Founderings, Capsizings, and Floodings	Deaths/Injuries Due to Vessel Casualty	Deaths/Injuries Due to Falls from Vessel into Water (Not involving a vessel casualty)
Passenger & Ferry Vessels (Inspected)	139	5	12/8	7/1
Freight Vessels (Inspected)	510	2	5/13	11/4 (a)
Tank Ships (Inspected)	214	1	24/5	7/1 (a)
Barges, Cargo (Inspected)	113	5	0/0	- -
Barges, Tank (Inspected)	510	7	3/4	- -
Fishing Vessels (Uninspected)	625	39	68/15	35/1
Tugs (Uninspected)	1140	45	15/13	21/4
TOTALS	3251	104	127/58	81/11
Totals including other vessels	2703 (b)	106 (b)	184/116	111/11

(a) These data include barges (freight ships and barges, tankships and barges)
(b) These total casualties include cases involving more than one vessel.
The average number of vessels involved are 4415.

TABLE 8. CASUALTY DATA ASSOCIATED WITH SELECTED CIRCUMSTANCES
(Average for Fiscal Years 1973, 1972, 1971)

Casualty Circumstance	Vessel Casualties		Deaths Due to Vessel Casualties		Deaths Due to Falls into Water (No Vessel Casualty)	
	Number	Percent	Number	Percent	Number	Percent
Total number of vessels	4415					
Total number of casualties	2703					
Total number of deaths			184		112	
Drownings			114	62%	104	93%
Other deaths			70	38%	8	7%
Inspected vessels	1564	35.4%	51	27.7%	29	25.9%
Uninspected vessels	2851	64.6%	133	72.3%	83	74.1%
Daylight	1506	55.7%			58	51.8%
Night or twilight	1197	44.3%			54	48.2%
Vessel at dock, anchor, or other			42	22.8%	33	29.5%
Vessel underway			142	77.2%	79	70.5%
Personnel off-duty			16	8.7%	21	18.8%
Deck duty			49	26.6%	44	39.3%
Fishing			35	19.0%	16	14.3%
Passenger			17	9.2%	10	8.9%
Other activities			67	36.4%	21	18.8%
Vessel location inland (includes coastal, rivers, lakes)	2076	76.8%				
Vessel location ocean	627	23.2%				
Vessel age less than 10 years	1707	38.7%				
Vessel age 10 to 20 years	1153	26.1%				
Vessel age 20 to 30 years	856	19.4%				
Vessel age over 30 years	699	15.8%				

TABLE 9. FACTORS INDICATING THE PROBABILITY OF OCCURENCE OF VARIOUS CASUALTY EVENTS ASSOCIATED WITH VESSEL CLASSES

Vessel Classes	Given that a vessel casualty occurs Probability (%) for vessel class involvement	Given that a foundering capsizing or flooding occurs. Probability (%) for vessel class involvement	Given that a death occurs due to a vessel casualty. Probability (%) for vessel class involvement	Given that a death occurs due to falls from vessel into water & no vessel casualty Probability (%) for vessel class involvement.	Given that a death or injury occurs due to falls from vessel into water & no vessel casualty. Probability (%) for vessel class involvement
Inspected Passenger/Ferry	5.15%	4.71%	6.52%	6.30%	6.55%(a)
Inspected Freight (Cargo)	18.9%	1.88%	2.72%	9.92%(a)	12.3%
Inspected Tankship	7.92%	0.94%	13.0%	6.30%(a)	6.55%(a)
Inspected Barge - Cargo	4.18%	4.71%	0	- -	- -
Inspected Barge - Tank	18.9%	6.60%	1.63%	- -	- -
Uninspected Fishing Vessel	23.1%	36.8%	37.0%	31.5%	29.5%
Uninspected Tug	42.2%	42.5%	8.15%	18.9%	20.5%
Other than above	6.07%	1.88%	31.0%	27.0%	25.4%

(a) Includes barges

Discussion of Analysis Results

The brief analysis made of data from the statistical summaries provide some general guidance on personnel hazards relative to various circumstances.

As indicated in Table 8, about 65% of the vessels involved in vessel casualties are uninspected vessels. Similarly, about 72% of deaths due to vessel casualties and 74% of deaths due to falls into the water involve uninspected vessels. The significance of these proportions is affected by the consideration that there are on the order of four uninspected vessels for each inspected vessel in commercial use (for vessels over 5 net tons).

Also, as indicated in Table 8, the relative number of vessel casualties and personnel deaths occurring in daytime is slightly more than those occurring at night. About 30% of personnel deaths occur when vessels are at dock or anchor and about 70% occur when vessels are underway. The data indicate also that about 3/4 of all reported vessel casualties occur on inland waterways (assumed to include intercoastal areas) and relatively newer vessels are involved in more casualties than older vessels.

The data indicate that crewmen engaged in deck duty activities may be exposed to greater hazards than crewmen engaged in other activities. It is interesting to note that about 1/5 of the deaths resulting from falls into the water (no vessel casualty) are by off-duty crewmen.

Table 9 provides a more detailed breakdown of hazards according to vessel classes. These details indicate the relatively high hazards to personnel on tugs and fishing vessels. However, as noted previously the significance of these data is affected by the relatively high ratio of uninspected vessels to inspected vessels in service.

Vessel casualties involving inspected tankships are relatively more likely to result in personnel deaths than vessel casualties involving other classes of inspected vessels. Relatively more personnel are lost by falls into the water from inspected freight vessels than from other classes of inspected vessels, however.

8.2 Data Developed From Casualty Summaries

As previously indicated brief summaries were prepared of casualty cases selected from U.S. Coast Guard records. These summaries were categorized for this study according to two general types; (1) casualty cases involving vessel abandonment, and (2) casualty cases involving falls from vessels into water. Further categorizations included consideration of vessel classes and selected casualty circumstances. Much of the data derived from analysis of the casualty cases are presented in tabular form arranged under the two general categories listed above.

Vessel Abandonment

The review of Coast Guard casualty case records for Fiscal Years 1973, 1972, and 1971, plus selected cases for which U.S. Coast Guard Marine Board Review summaries were available resulted in the compilation of data from a total of 447 vessel casualty cases involving abandonment by personnel. There were approximately 44 additional cases for which brief summaries were prepared that did not contain sufficient information for data compilation.

Some general comparisons can be made to illustrate the relative significance of the data base obtained for this study. No direct comparisons can be made because the statistical summaries of vessel casualty cases prepared by the Coast Guard do not indicate the number of vessel casualty cases that involve personnel abandonment. Also, there are some uncertainties relative to the correlation of vessel classes selected for this study and vessel classes used in the statistical summaries. Table 10 illustrates, in general, that the data base used for this study includes a relatively high proportion of the personnel deaths associated with vessel casualty cases for the three Fiscal Years, 1973, 1972, and 1971. For example, the casualty cases reviewed and included in the data base (for this time period) involved a total of 184 personnel losses or approximately 33.4% of the total personnel losses derived from the statistical summaries. It is important to recognize that the total personnel losses derived from the statistical

TABLE 10. COMPARISON OF PERSONNEL LOSSES DERIVED FROM ANALYSIS OF VESSEL CASUALTY CASES (WITH ABANDONMENT) AND U.S. COAST GUARD STATISTICAL SUMMARIES

Vessel Classes	Personnel Data From Casualty Cases Reviewed & Summarized-Fiscal Years 1973, 1972, & 1971. (Not Including Marine Board Cases From Prior Years)				Personnel Data From Marine Board Cases Reported Prior To FY 1971				Total Personnel Data From Casualty Cases Reviewed & Summarized				Personnel Losses Obtained From U.S. Coast Guard Statistical Summaries for FY 1973,1972, & 1971 (Includes Losses Other Than Due To Abandonment)
	NUMBER OF PERSONS ON BOARD	NUMBER OF PERSONS ABANDONING	NUMBER OF PERSONS SAVED	NUMBER OF PERSONS LOST	NUMBER OF PERSONS ON BOARD	NUMBER OF PERSONS ABANDONING	NUMBER OF PERSONS SAVED	NUMBER OF PERSONS LOST	NUMBER OF PERSONS ON BOARD	NUMBER OF PERSONS ABANDONING	NUMBER OF PERSONS SAVED	NUMBER OF PERSONS LOST	
Passenger (Large)	238	202	230	8	702	605	602	100	940	807	832	108	37
Passenger (Small)	861+	856	858+	1	20	20	15	5	881+	876	873+	6	
Freight	98+	98	98	0	202	171	104	98	300+	269	202	98	14
Tanker	63+	32+	14+	10	236+	142+	170+	94	299+	174+	184+	104	73
Barges	16	15	12	4	8	1	1	7	24+	16+	13+	11	11
Tugs & Towing	230+	211+	188+	42	12+	-	-	11	242+	211+	189+	53	45
Platforms & Drilling	223+	222+	214+	9	37	37	37	0	260+	259+	251+	9	--
Miscellaneous	188+	136	148	40	45	38	19	26	233+	174	167	66	--
Fishing (Large)	372	369	348	24	14	14	7	7	386+	383+	355+	31	203
Fishing (Small)	461	389	413	46	0	0	0	0	461+	389+	413+	46	
Other (Includes Platforms and Foreign Vessels)													168
Total	2750+	2530+	2523+	184	1276+	1028+	956+	348	4026+	3558+	3479+	532	551

summaries includes personnel losses associated with vessel casualties and without vessel abandonment activities.

To provide more comprehensive information on vessel abandonment type casualty events, the data from 31 additional cases that were reported prior to FY 1971 and subject to Marine Board Review action were added to the data base. These cases are mainly for larger vessels (Inspected Passenger, Freight, Tanker, and Offshore Platforms/Drill Vessels). The addition of these cases is believed to provide a data base that is representative of more than three years of experience for large vessel casualty and abandonment situations while retaining adequate representation of smaller vessel casualty and abandonment situations.

The analysis of data derived from the vessel casualty summaries was carried out in three ways:

(1) Tabulations were made of casualty events that were anticipated to be significant in the consideration of survival system functional requirements. These tabulations, Tables 11 and 12, are detailed according to vessel classes. Also, it was anticipated that casualty situations initiated by vessel fires might include some variations in casualty events that would be significantly different from other vessel casualty causes. Therefore, two sets of tabulations were prepared.

(2) Tabulations (Tables 13 through 29) were made of abandonment and retrieval actions arranged according to vessel classes illustrating personnel activities. Tables 13 through 21 are for vessel abandonments initiated by vessel casualties excluding vessel fires. Tables 22 through 29 display the effects of casualty situations initiated by vessel fires. Because not all casualty summary accounts that were prepared contained information on personnel activities, the data base for these tabulations were reduced somewhat to approximately 360 cases. These tabulations were particularly useful in developing input parameters used in the computer simulation of vessel abandonment events.

TABLE 11. ANALYSIS OF CASUALTY DATA - VESSEL CASUALTY AND ABANDONMENT
(Fiscal Years 1973, 1972, and 1971)

EVENTS	Passenger Vessels (Small & Large)	Freight Vessels	Tanker Vessels	Barges	Tugs and Towing Vessels	Platforms and Drilling Vessels	Miscellaneous Vessels	Fishing Vessel (Large)	Fishing Vessel (Small)	Fishing Vessels (Large & Small)	Total All Vessel Classes
Approximate Number of Vessels in Service	4,000	2,300	400	3,000	6,000	250	- -	13,000 (5 net tons or more) 83,000 (total)			
Average Vessel Age (Years)	17.4	22	17	6.7	25.2	7.1	17.6	25.4	25.4	24.0	22.1
Percent Vessels Inspected	57.7	54.5	100.0	75.0	0.0	10.0	18.0	7.8	5.2	6.11	15.2
Percent Cases at Night (Not Day)	25.8	61.5	100.0	25.0	44.7	10.0	42.5	50	41.1	44.3	42.7
Percent Cases in Ocean Waters (Not Inland)	80.6	92.3	100.0	50.0	36.7	100.0	77.5	96	94	94.8	83.5
Percent Cases With Vessel at Dock or Tied Off	3.2	7.7	0.0	25.0	10.0	80.0	20.5	2.6	0.8	1.4	7.4
Percent Cases Radio Used to Call for Help	32.3	38.5	33.3	0.0	12.0	20.0	27.5	39	29.1	32.7	28.8
Percent Cases Flares or Other Signals for Help Used	9.7	7.7	50.0	0.0	8.0	0.0	10.0	2.6	3.7	3.3	6.0
Percent Cases Lifeboat Launch Attempted	12.5	45.4	80.0	0.0	3.2	0.0	19.1	18.9	25.0	22.2	19.8
Percent Success Rate for Lifeboat Launch (Given an Attempt)	100.0	80.0	75.0	- -	0.0	- -	25.0	78.6	86.4	83.3	77.4
Percent Cases Life Raft Launch Attempted	11.5	23.1	25.0	0.0	15.2	20.0	36.0	29.7	28.7	29.2	25.4
Percent Success Rate for Life Raft Launch (Given an Attempt)	100.0	66.7	100.0	- -	40.0	100.0	66.7	72.7	92.0	83.0	78.6
Percent Cases that Personnel Jumped Into Water	33.3	30.8	60.0	75.0	51.1	50.0	40.0	18.9	39.2	31.7	36.7
Percent Jumped With Floatation (Given That Personnel Jumped)	63.1	87.1	100.0	33.3	58.1	69.1	56.0	70.2	59.5	63.0	66.2
Percent Cases That Personnel Used Direct Transfer or Other Means	54.8	38.5	33.3	50.0	58.3	40.0	45.7	40.5	36.6	38.0	43.2
Percent Cases That Personnel Remained Onboard and Were Lost	3.2	0.0	50.0	25.0	10.0	10.0	12.5	2.8	0.8	1.5	5.0
Percent Cases That Rescue Vessel Is On Scene Or Very Near	41.9	23.1	0.0	75.0	28.0	60.0	25.0	27.3	32.1	32.2	32.0
Average Length of Time for Arrival of Rescue (Minutes)	53	233	292	0.0	532	4	375	205	83	147.9	188.8
Average Length of Time for Death of Personnel in Water With Floatation	- -	45.0	- -	30.0	120.0	- -	- -	46.7	- -	46.7	61.0
Average Length of Time for Death of Personnel in Water W/O Floatation	- -	- -	- -	- -	5.3	- -	- -	30	1	15.5	9.4
Average Length of Time for Death of Personnel in Raft (Minutes)	- -	- -	- -	- -	- -	- -	- -	- -	240	240	240
Average Length of Time for Death of Personnel in Lifeboat (Minutes)	- -	- -	- -	- -	- -	- -	- -	- -	24	24	24
Average Visibility (Miles)	7.15	8.25	5.7	10.0	6.37	5.75	7.51	6.68	6.85	6.78	6.85
Average Wind Velocity (Knots)	10.79	36.25	29.2	14.0	16.82	19.33	18.43	21.66	24.64	23.52	21.48
Average Wave Height (Feet)	3.96	9.69	14.0	3.25	3.88	4.12	6.16	6.67	6.48	6.55	6.11
Average Air Temperature ($^{\circ}$ F)	68.48	56.43	52.0	45.5	59.65	81.25	60.76	56.3	54.83	55.36	58.11
Average Water Temperature ($^{\circ}$ F)	63.7	49.5	58.0	29.0	30.0	70.0	66.11	49.7	54.42	52.9	54.84
Average Number of Personnel Abandoning Per Vessel	35.13	14.9	21.4	1.75	3.31	23.54	4.71	3.92	2.75	3.18	7.4
Percent of Personnel Abandoning That Are Saved	99.08	65.4	77.57	85.7	86.42	96.91	93.68	90.0	87.4	88.6	91.4
Number of Casualty Cases Reviewed	31	13	6	4	50	10	40	77	134	211	365

(a) Includes data from selected cases in prior years that were reviewed by the NTSB.

TABLE 12. ANALYSIS OF CASUALTY DATA - VESSEL FIRE AND ABANDONMENT
(Fiscal Years 1973, 1972, and 1971)

EVENTS	PASSENGER VESSELS (Small & Large)	FREIGHT VESSELS	TANKER VESSELS	BARGES	TUGS AND TOWING VESSELS	FISHING VESSEL (Large)	FISHING VESSEL (Small)	FISHING VESSELS (Large & Small)	TOTAL ALL VESSEL CLASSES
Approximate Number of Vessels in Service	4,000	2,300	400	3,000	6,000	13,000 (5 net tons or more) 83,000 (total)			
Average Vessel Age (Years) (Known Cases)	16.9	18.5	8.8	7.0	18.8	17.2	18.4	17.6	17.1
Percent Vessels Inspected (Known Cases)	36.4	- -	40	50.0	0.0	7.7	7.1	7.5	14.1
Percent of Cases at Night (Not Day) (Known Cases)	16.7	100.0	50	33.3	20.0	34.6	21.4	30.0	30.4
Percent Cases in Ocean Waters (Not Inland) (Known Cases)	91.7%	0.0	83.3	25.0	6.3	92.3	92.8	92.5	67.9
Percent Cases With Vessel at Dock or Tied Off (Known Cases)	8.3%	33.3	16.7	75.0	6.7	0.0	0.0	0.0	8.8
Percent Cases Radio Used to Call for Help (% of Total)	25%	0.0	75	0.0	25.0	19.2	26.7	22.0	23.2
Percent Cases Flares or Other Signals for Help Used (% of Total)	8.3%	0.0	- -	0.0	6.3	0.0	13.3	4.9	6.1
Percent Cases Lifeboat Launch Attempted (Known Cases)	16.7%	33.3	50	0.0	0.0	44.4	26.7	36.4	27.9
Percent Success Rate for Lifeboat Launch (Given an Attempt)	100%	100%	100	- -	- -	87.5	75	83.3	88.2
Percent Cases Life Raft Launch Attempted	28.6%	0.0	0.0	0.0	10.0	30.4	13.3	23.7	17.6
Percent Success Rate for Life Raft Launch (Given an Attempt)	100%	- -	- -	- -	0.0	85.7	50	77.8	75.0
Percent Cases That Personnel Jumped Into Water	27.3%	66.7	83.3	100.0	42.9	12.5	57.1	29.0	40.8
Percent Jumped With Floatation (Given That Personnel Jumped)	66%	0.0	80	14.0	50.0	100	68.4	72.7	58.1
Percent Cases That Personnel Used Direct Transfer or Other Means	54.5%	33.3	33.3	75.0	50.0	37.5	21.4	31.6	40.8
Percent Cases That Personnel Remained On Board and Were Lost	16.7%	33.3	33.3	50.0	18.8	0.0	0.0	0.0	12.8
Percent Cases That Rescue Vessel Is On Scene Or Very Near	44.4%	66.7	83.3	25.0	50.0	26.9	13.3	22.0	32.9
Average Length of Time for Arrival of Rescue Capability (Minutes)	21.7	27.7	30	- -	- -	51	77.5	62.8	40.6
Average Length of Time for Death of Personnel in Water With Floatation (Minutes)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Average Length of Time for Death of Personnel in Water W/O Floatation (Minutes)	- -	- -	- -	- -	- -	- -	22.5	22.5	22.5
Average Length of Time for Death of Personnel in Raft (Minutes)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Average Length of Time for Death of Personnel in Lifeboat (Minutes)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Average Visibility	9.7	10	8.7	7.7	8.7	6.17	8.9	7.2	8.1
Average Wind Velocity	8.6	14	19	3.0	12.4	17.25	12.5	15.7	13.6
Average Wave Height	2.0	- -	2	0.0	2.2	4.8	3.8	4.5	3.3
Average Air Temperature	71.6	51.3	70	58.7	75.1	52.4	67.2	58.2	63.4
Average Water Temperature	70.2	- -	65	- -	63.3	57.0	63.7	61.7	61.3
Average Number of Personnel Abandoning Per Vessel	49.5	30	33.5	3.0	3.5	3.83	2.28	3.26	13.0
Percent of Personnel Abandoning That Are Saved	99.5	94.4	94.0	78.0	90.0	100.0	93.8	98.4	98.1
Number of Casualty Cases Reviewed	12	3	6	4	16	26	15	41	82

(a) Includes data from selected cases in prior years that were reviewed by the NTSB.

(3) As casualty case records were studied for the derivation of data that could be summarized in tabular form, judgements were made by project personnel on typical and unusual event sequences that comprise vessel abandonment activities.

Consideration of Analysis Results

There are several significant observations that can be made based on the analysis of data on vessel casualty and abandonment.

(1) The average age of vessels involved in casualty situations is 22.1 years for vessel casualty and abandonment and 17.1 years for vessel fire and abandonment. These relatively long periods of time suggest the need for periodic operation, refurbishment, and possibly modernization of survival system equipment.

(2) Except for tugs and barges, a relatively high percentage of vessel casualty and abandonment cases occur in ocean waters with the vessel underway.

(3) Radio calls for help were reported for less than 1/3 of the cases reviewed. It is recognized that this apparently low percentage may in part be the result of reporting omissions.

(4) In approximately 37 percent of all casualty cases reviewed, personnel abandoned by jumping into the water. This mode of vessel abandonment appears particularly dominant for tank vessels and barges and least dominant for large fishing vessels.

(5) It is interesting to note that in about 32% of all casualty cases, potential rescue vessels were on scene or near by. Also, for vessel casualties involving fires, it was evident from review of casualty accounts that the fire and resulting smoke were effective in alerting nearby vessels that assistance was needed.

(6) The relative severity of the environment appears to significantly influence the chance of survival. Figures 4 and 5 illustrate that more severe environmental conditions generally result in reduced proportions of persons saved versus persons abandoning. The approximate trends are evident considering that very few cases were available for some of the environmental conditions. Additional data on the environmental conditions encountered during casualty situations are shown in a later section.

(7) The worst case environmental conditions reported include winds up to 180 knots, and waves up to 40 feet. Air temperatures as low as 0 F and water temperatures as low as 32 F were also reported. As indicated in the tables summarizing the analysis of vessel casualty and abandonment situations, the average values are substantially less severe than the worst case values. As a further aid in analysis of the environmental conditions, estimates were made of "severe" conditions that would not be expected to be exceeded in 90% of all casualty cases. These "severe" conditions selected from all vessel abandonment situations are:

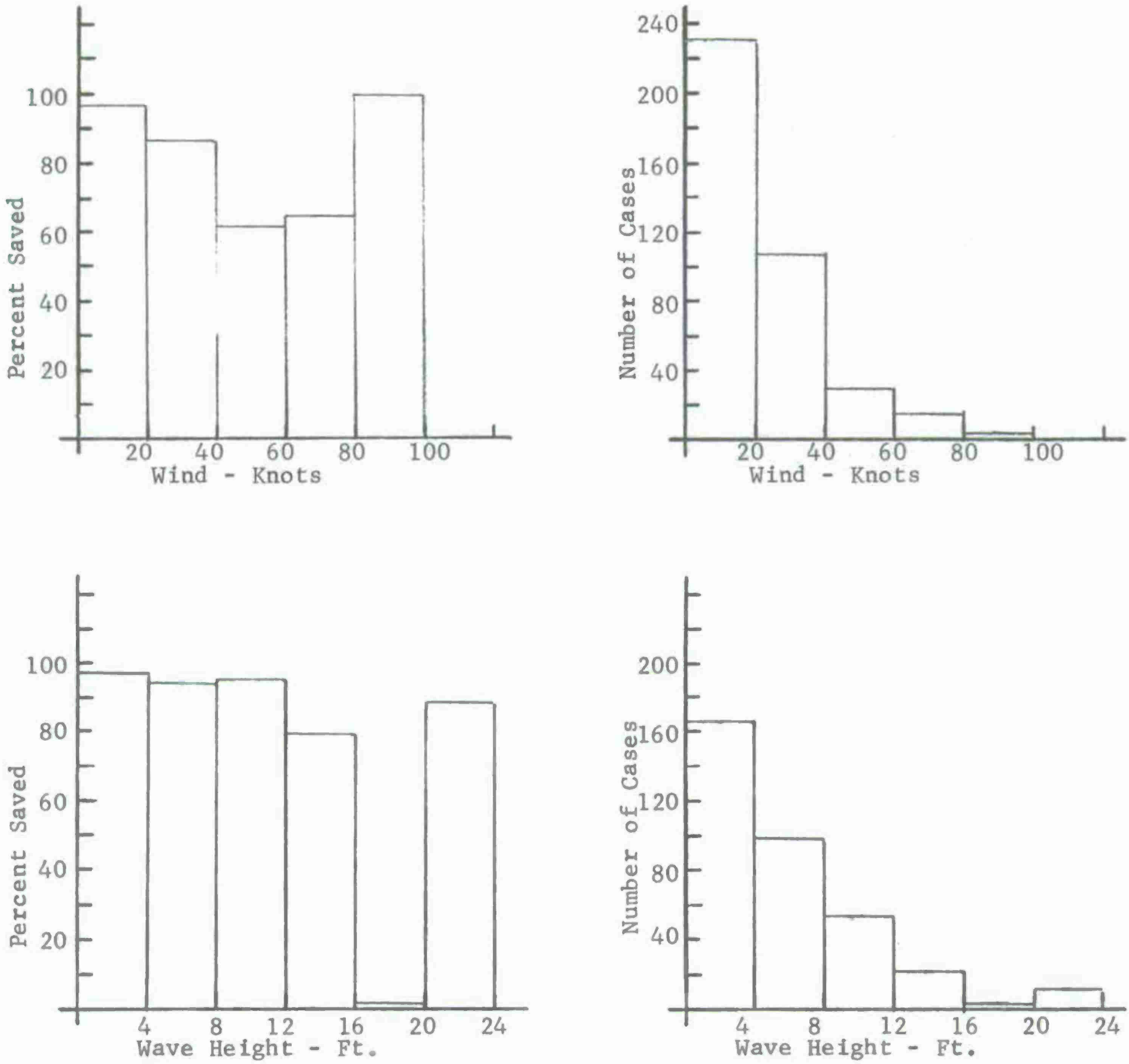

FIGURE 4. Relative Effects of Wind and Wave Conditions - All Vessel Classes - Percent saved is obtained from ratio of number of persons saved to number abandoning. Number of cases illustrates the number of vessel casualty cases reviewed with environmental conditions reported within the selected ranges of values.

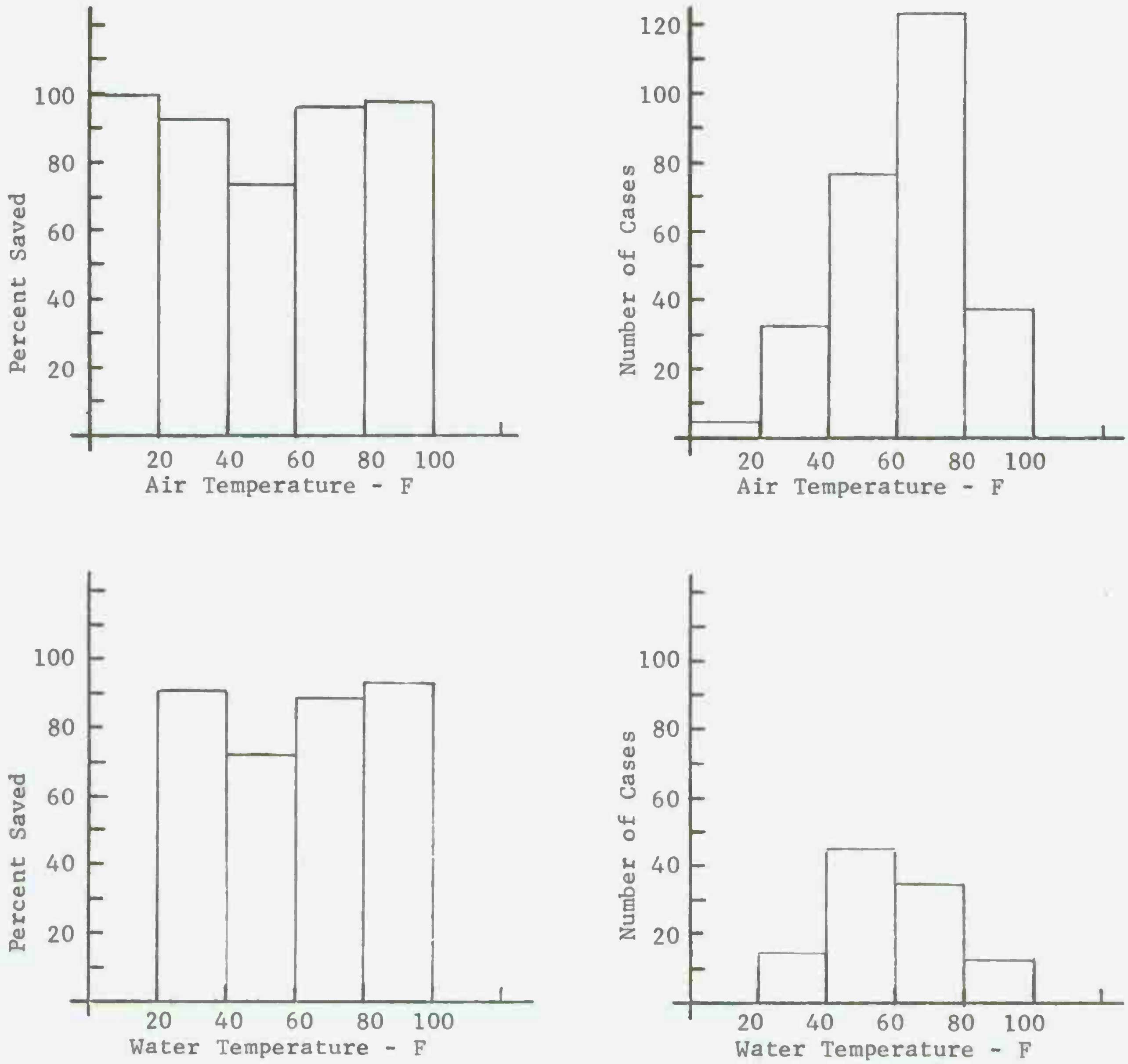

FIGURE 5. Relative Effects of Air and Water Temperature - All Vessel Classes - Percent saved is obtained from ratio of number of persons saved to number abandoning. Number of cases illustrates the number of vessel casualty cases reviewed with environmental conditions reported within the selected ranges of values.

(1) Winds up to 56 knots

(2) Waves up to 36 feet

(3) Air temperatures down to 30 F

(4) Water temperatures down to 34 F.

For vessel classes subjected mainly to environments differing from the average other values apply. These are detailed by vessel classes in a later section of this report.

(8) Based on available data, it was found that the average time for death of personnel in the water with floatation was considerably longer than the time for death of personnel in the water without floatation.

(9) The overall chance of survival for persons going into the water for vessel abandonment situations seems to be significantly better than for man-overboard situations.

(10) About 36% of all persons lost (as a result of commercial vessel casualties) are from fishing vessel casualties. This relatively high percentage may be due in part to the relatively large number of fishing vessels in service. Other factors such as crew size and vessel utilization rates would need to be considered before any estimates on relative hazards could be made.

(11) The overall chance of survival for persons that abandon ship by means of either a lifeboat or a life raft appears to be very high. Also, based on rather limited data the average length of time for retrieval of persons in a lifeboat or life raft appears rather short with a worst case exposure time of approximately 18 hours for the cases reviewed.

Study of the vessel casualty cases involving abandonment by personnel resulted in the formulation of a "typical" profile for a vessel casualty/abandonment situation. From the viewpoint of personnel on board the main events are:

(1) Personnel on board (crewmen) are alerted that a vessel casualty has occurred and that vessel abandonment should be carried out. Obviously not all vessel casualty situations result in abandonment, therefore, the decision to abandon by the crewmen is separate and distinct from any actions taken to cope with the vessel casualty results in an attempt to save the ship. Also, considerable time may elapse between the initiation of a casualty and the decision to abandon. This time may be available to the individual crew member for preparation for abandonment such as donning life preservers. From analysis of casualty data, about 60% of the vessel casualty cases occur in the daytime, 80% are in ocean areas, 92% of the cases involve vessels underway, and, as previously indicated, radio calls for help were reported in only about 28% of the casualty cases reviewed.

(2) The next major event is the vessel abandonment process. There are at least four common methods of disembarking. These are by lifeboat, life raft, jumping overboard, and by direct transfer to another vessel or the utilization of some unusual circumstances that aids in direct transfer to a location of safety. As indicated by the casualty analysis data, on the average about 43% of the casualty cases involved some type of direct transfer process, life rafts were used in about 25% of the cases, lifeboats were used in about 20% of the cases, and in about 37% of the casualty

cases personnel jumped into the water (about 2/3 were wearing life preservers). The use of lifeboats was relatively more frequent for freight and tankers vessels--almost never used for barges, tugs, platforms and drilling vessels. The use of life rafts appears relatively consistent for all vessel classes except barges. The direct transfer mode of abandonment appeared also, to be relatively consistant for all vessel classes. It is interesting to note that jumping overboard appears relatively more prevalent for tankers, barges, tugs, platforms and drilling vessels.

(3) After vessel abandonment, personnel are then confronted with survival in their immediate environment.

(4) The last major event is the retrieval of personnel to a "safe" location. The elapsed time of exposure prior to retrieval is an obviously important consideration from the viewpoint of the personnel who abandoned the vessel. Unfortunately, the casualty records contained very limited data on the time associated with the various abandonment events.

(5) Depending somewhat on the cause of the vessel casualty, there is the possibility that personnel may remain aboard a sinking vessel. This event was mainly evident on fire and explosion cases where personnel were lost prior to vessel abandonment actions. Except for the vessel fire cases, the relative percentage of personnel remaining aboard and lost when the vessel sank was negligibly low.

TABLE 13. CASUALTY DATA - VESSEL ABANDONMENT
PASSENGER VESSELS, LARGE

ABANDONMENT		RETRIEVAL																					
ATTEMPT METHOD	NUMBER	SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
		SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT (fail) (succeed)																							
RAFT (fail) (succeed)	80											80										80	
JUMP	20																						
(float.)	6															6							
(No Float)	14															10	4					16	4
OTHER	102																			102		102	
TOTAL												80				16	4			102		198	4

TABLE 14. CASUALTY DATA - VESSEL ABANDONMENT
PASSENGER VESSELS, SMALL

ABANDONMENT		RETRIEVAL																					
ATTEMPT METHOD	NUMBER	SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
		SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT																							
(fail)																							
(succeed)																							
RAFT	19																						
(fail)																							
(succeed)	19											19										19	
JUMP	69																						
(float.)	62													7				55				62	
(No Float)	7																	7				7	
OTHER	600																			600		600	
TOTAL												19		9				62		600		688	

TABLE 15. CASUALTY DATA - VESSEL ABANDONMENT
FREIGHT VESSELS

ABANDONMENT		RETRIEVAL																					
ATTEMPT METHOD	NUMBER	SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
		SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT	99																						
(fail)	35																	30	5				
(succeed)	64			35		29																94	5
RAFT	23																						
(fail)																							
(succeed)	23											23										23	
JUMP	14																						
(float.)	7																	7					
(No Float)	7																	7				14	
OTHER	130																	3		127		130	
TOTAL				35		29						23						47	5	127		261	5

TABLE 16. CASUALTY DATA - VESSEL ABANDONMENT
BARGE, CARGO

ABANDONMENT		RETRIEVAL																					
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT (fail) (succeed)																							
RAFT (fail) (succeed)																							
JUMP (float.) (No Float)	3 2 1																	2	1			2	1
OTHER	11																			4	7	4	7
TOTAL																		2	1	4	4	6	8

TABLE 17. CASUALTY [illegible] - VESSEL ABANDONMENT FIS IN VESSEL, LARGE

ABANDONMENT		RETRIEVAL																							
ATTEMPT METHOD	NUMBER	SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
		SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT	55																						
(fail)	2																	2					
(succeed)	53			6		4																55	
RAFT	66																						
(fail)																							
(succeed)	66							17		15		34										66	
JUMP	54					2																	
(float.)	36															7	1	17	11				
(No Float)	16															5	3	5	3			36	18
OTHER	85																			85		85	
TOTAL				6		49		1		15		34				12	4	24	14	85		242	18

TABLE 18. CASUALTY DATA - VESSEL ABANDONMENT FISHING VESSELS, SMALL

ABANDONMENT		RETRIEVAL																					
ATTEMPT METHOD	NUMBER	SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
		SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT	42																						
(fail)	6															5	1						
(succeed)	36			11		25																41	1
RAFT	40																1						
(fail)	1																						
(succeed)	39							5		5	1	28										38	2
JUMP	86											13	1										
(float.)	53														1	1	4	47					
(No Float)	15													2	2			8	3	4		75	11
OTHER	61																			61		61	
TOTAL				11		25		5		5	1	41	1	2	3	6	6	55	3	65		215	14

TABLE 19. CASUALTY DATA - VESSEL ABANDONMENT
TUGBOAT/TOWBOAT

ABANDONMENT		RETRIEVAL																					
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT																							
(fail)																							
(succeed)																							
RAFT	10																						
(fail)	7															3	1	3					
(succeed)	3											3										9	1
JUMP	31																						
(float.)	21														1	5	1	14					
(No Float)	10																	8	2			27	4
OTHER	62															1				61		62	
TOTAL												3			1	9	2	25	2	61		98	5

TABLE 20. CASUALTY DATA - VESSEL ABANDONMENT
PLATFORM/DRILLING VESSELS

ABANDONMENT		RETRIEVAL																			
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT																							
(fail)																							
(succeed)																							
RAFT	25																						
(fail)																							
(succeed)	25											25										25	
JUMP	64																						
(float.)	62																	60	2				
(No Float)	2																		2			60	4
OTHER	151																			151		151	
TOTAL												25						60	4	151		236	4

TABLE 21. CASUALTY DATA - VESSEL ABANDONMENT
MISCELLANEOUS VESSELS

ABANDONMENT		RETRIEVAL																					
ATTEMPT METHOD	NUMBER	SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
		SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT	7																						
(fail)	2													2				2					
(succeed)	5					5																7	
RAFT	19																						
(fail)	2																						
(succeed)	17							1		3		13										19	
JUMP	89											6											
(float.)	50															34		16					
(No Float)	33															1	4	16	12			73	16
OTHER	39																			39		39	
TOTAL						5				3		19		2		35	4	34	12	39		138	16

Vessel Fires

Tables 22 through 29 are compilations of data on personnel involved in vessel fire casualties. Not all vessel fires resulted in ship abandonment.

Referring to Table 22, a summary tabulation, the first section of the table relates to fire-fighting events and selected circumstances. For example, of a total of 1345 persons involved with ship fires, 324 abandoned the vessel and the remainder (1021) stayed aboard. Of the 324 who abandoned the vessel, 81 persons used lifeboats (or other small craft), 29 persons used life rafts, 74 jumped from the vessel (one into a small boat) and 140 abandoned by other means (generally direct transfer to another vessel or on the dock). All the persons in rafts and lifeboats were saved and only 8 persons jumping into the water were lost. A larger number (62 persons) were lost in the fire on board.

Tables 23 through 29 show the numerical details associated with various vessel classes. Because of similarities in data and limited data for some vessel classes, details are not listed for all vessel classes. Data for large and small passenger vessels are combined in one table and data for barges (generally tank barges) are combined with tanker vessels.

TABLE 22. CASUALTY DATA VESSEL FIRE WITH AND WITHOUT ABANDONMENT - ALL VESSELS

FIRE				
FIRE EVENTS	PERSONS ON BOARD	PERSONS NOT ABANDONING	PERSONS SAVED BEFORE ABANDONMENT	PERSONS LOST BEFORE ABANDONMENT
AUTOMATIC EQUIPMENT EXTINGUISHES FIRE	88	88	88	0
CREW ATTEMPTS TO EXTINGUISH FIRE	623	494	564	59
CREW ASSISTED BY OTHERS	571	439	568	3
NO ATTEMPT MADE TO EXTINGUISH FIRE	63	0	63	0
TOTAL	1345	1021	1283	62

ABANDONMENT		RETRIEVAL																									
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT (fail) (succeed)	81			21		60																81	0
RAFT (fail) (succeed)	29									14		15										29	0
JUMP	1					1																1	0
(float.)	28															3		25				28	0
(No Float)	45															3	1	36	7			37	8
OTHER	140																			140		140	0
TOTAL	324			21		61				14		15				4	1	61	7	140		316	8

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TABLE 23. CASUALTY DATA VESSEL FIRE WITH AND WITHOUT ABANDONMENT PASSENGER VESSELS, LARGE AND SMALL

FIRE					ABANDONMENT		RETRIEVAL																						
							SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
							LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
FIRE EVENTS	PERSONS ON BOARD	PERSONS NOT ABANDONING	PERSONS SAVED BEFORE ABANDONMENT	PERSONS LOST BEFORE ABANDONMENT	ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
AUTOMATIC EQUIPMENT EXTINGUISHES FIRE					BOAT (fail) (succeed)																							
CREW ATTEMPTS TO EXTINGUISH FIRE	15	10	15	0	RAFT (fail) (succeed)	3									2		1										3	0
CREW ASSISTED BY OTHERS	140	131	140	0	JUMP (float.) (No Float)	1																		1			1	0
NO ATTEMPT MADE TO EXTINGUISH FIRE	2	0	2	0	OTHER	12																			12		12	0
TOTAL	157	141	157	0	TOTAL	16									2		1							1	12		16	0

TABLE 24. CASUALTY DATA VESSEL FIRE WITH AND WITHOUT ABANDONMENT FREIGHT

FIRE EVENTS	PERSONS ON BOARD	PERSONS NOT ABANDONING	PERSONS SAVED BEFORE ABANDONMENT	PERSONS LOST BEFORE ABANDONMENT
AUTOMATIC EQUIPMENT EXTINGUISHES FIRE	79	79	79	0
CREW ATTEMPTS TO EXTINGUISH FIRE	344	283	319	25
CREW ASSISTED BY OTHERS	267	267	267	0
NO ATTEMPT MADE TO EXTINGUISH FIRE				
TOTAL	690	629	665	25

ABANDONMENT		RETRIEVAL																					
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT (fail) (succeed)																							
RAFT (fail) (succeed)																							
JUMP (float.) (No Float)	26																	26				26	0
OTHER	35																			35		35	0
TOTAL	61																					61	0

TABLE 25. CASUALTY DATA VESSEL FIRE WITH AND WITHOUT ABANDONMENT TANKER/BARGE

FIRE EVENTS	FIRE: PERSONS ON BOARD	FIRE: PERSONS NOT ABANDONING	FIRE: PERSONS SAVED BEFORE ABANDONMENT	FIRE: PERSONS LOST BEFORE ABANDONMENT
AUTOMATIC EQUIPMENT EXTINGUISHES FIRE				
CREW ATTEMPTS TO EXTINGUISH FIRE	95	95	95	0
CREW ASSISTED BY OTHERS	115	37	80	35
NO ATTEMPT MADE TO EXTINGUISH FIRE	8	0	8	0
TOTAL	218	132	183	35

ABANDONMENT: ATTEMPT METHOD	ABANDONMENT: NUMBER	RETRIEVAL: SMALL BOAT, LONG TIME, SAVED	SMALL BOAT, LONG TIME, LOST	SMALL BOAT, MED. TIME, SAVED	SMALL BOAT, MED. TIME, LOST	SMALL BOAT, SHORT TIME, SAVED	SMALL BOAT, SHORT TIME, LOST	RAFT, LONG TIME, SAVED	RAFT, LONG TIME, LOST	RAFT, MED. TIME, SAVED	RAFT, MED. TIME, LOST	RAFT, SHORT TIME, SAVED	RAFT, SHORT TIME, LOST	WATER, LONG TIME, SAVED	WATER, LONG TIME, LOST	WATER, MED. TIME, SAVED	WATER, MED. TIME, LOST	WATER, SHORT TIME, SAVED	WATER, SHORT TIME, LOST	FROM VESSEL, SAVED	FROM VESSEL, LOST	TOTAL, SAVED	TOTAL, LOST
BOAT																							
(fail)																							
(succeed)	38					38																38	0
RAFT																							
(fail)																							
(succeed)																							
JUMP	12					1																1	0
(float.)	1																	1				1	0
(No Float)	10																	4	6			4	6
OTHER	36																			36		36	0
TOTAL	86					39												5	6	36		80	6

TABLE 26. CASUALTY DATA VESSEL FIRE WITH AND WITHOUT
ABANDONMENT FISHING VESSELS, LARGE

FIRE				
FIRE EVENTS	PERSONS ON BOARD	PERSONS NOT ABANDONING	PERSONS SAVED BEFORE ABANDONMENT	PERSONS LOST BEFORE ABANDONMENT
AUTOMATIC EQUIPMENT EXTINGUISHES FIRE	9	9	9	0
CREW ATTEMPTS TO EXTINGUISH FIRE	63	4	63	0
CREW ASSISTED BY OTHERS	7	0	7	0
NO ATTEMPT MADE TO EXTINGUISH FIRE	21	0	21	0
TOTAL	100	13	100	0

ABANDONMENT		RETRIEVAL																					
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT (fail) (succeed)	35			18		17																	
RAFT (fail) (succeed)	11											11											
JUMP (float.) (No Float)	9															3		6					
OTHER	32																			32			
TOTAL	87			18		17						11				3		6		32		87	0

TABLE 27. CASUALTY DATA VESSEL FIRE WITH AND WITHOUT ABANDONMENT, FISHING VESSELS, SMALL

FIRE				
FIRE EVENTS	PERSONS ON BOARD	PERSONS NOT ABANDONING	PERSONS SAVED BEFORE ABANDONMENT	PERSONS LOST BEFORE ABANDONMENT
AUTOMATIC [illegible] EXTINGUISHES FIRE				
CREW ATTEMPTS TO EXTINGUISH FIRE	18	4	18	0
CREW ASSISTED BY OTHERS				
NO ATTEMPT MADE TO EXTINGUISH FIRE	13	0	13	0
TOTAL	31	4	31	0

ABANDONMENT		RETRIEVAL																					
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT (fail)																							
(succeed)	8			3		5																8	0
RAFT (fail)																							
(succeed)	2											2										2	0
JUMP (float.)	11																	11				11	0
(No Float)	5															1	1	2	1			3	2
OTHER	1																			1		1	0
TOTAL	27			3		5						2				1	1	13	1	1		25	2

TABLE 28. CASUALTY DATA VESSEL FIRE WITH AND WITHOUT ABANDONMENT TUGBOAT/TOWBOAT

FIRE EVENTS	PERSONS ON BOARD	PERSONS NOT ABANDONING	PERSONS SAVED BEFORE ABANDONMENT	PERSONS LOST BEFORE ABANDONMENT
AUTOMATIC EQUIPMENT EXTINGUISHES FIRE				
CREW ATTEMPTS TO EXTINGUISH FIRE	21	10	21	0
CREW ASSISTED BY OTHERS	31	27	30	1
NO ATTEMPT MADE TO EXTINGUISH FIRE	16	0	16	0
TOTAL	68	37	67	1

ABANDONMENT		RETRIEVAL																					
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT (fail) (succeed)																							
RAFT (fail) (succeed)																							
JUMP (float.)	7																	7				7	0
(No Float)	3																	3				3	0
OTHER	21																			21		21	0
TOTAL	31																	10		21		31	0

TABLE 29. CASUALTY DATA VESSEL FIRE WITH AND WITHOUT ABANDONMENT MISCELLANEOUS VESSEL

FIRE				
FIRE EVENTS	PERSONS ON BOARD	PERSONS NOT ABANDONING	PERSONS SAVED BEFORE ABANDONMENT	PERSONS LOST BEFORE ABANDONMENT
AUTOMATIC EQUIPMENT EXTINGUISHES FIRE				
CREW ATTEMPTS TO EXTINGUISH FIRE	67	54	67	0
CREW ASSISTED BY OTHERS	11	11	10	1
NO ATTEMPT MADE TO EXTINGUISH FIRE	3	0	3	0
TOTAL	81	65	80	1

ABANDONMENT		RETRIEVAL																					
		SMALL BOAT						RAFT						WATER						FROM VESSEL		TOTAL	
		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME		LONG TIME		MED. TIME		SHORT TIME					
ATTEMPT METHOD	NUMBER	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST	SAVED	LOST
BOAT (fail) (succeed)																							
RAFT (fail) (succeed)	13									12		1										13	
JUMP (float.) (No Float)																							
OTHER	3																			3		3	
TOTAL	16									12		1								3		16	

Falls From Vessel Into Water

The review of Coast Guard casualty case records for Fiscal Years 1973, 1972, and 1971 resulted in the preparation of summaries of 259 man overboard casualty cases. There were a total of 240 persons lost (mostly by drowning) for these cases and 30 persons saved. According to Coast Guard statistical summaries for this same time period, there were a total of 335 persons lost by falls from vessel into the water (not involving a vessel casualty). Therefore, the data base available for this analysis represents approximately 72% of all the man overboard cases.

Because of variations in the extent of detail available in the case records, not all parameters of interest could be tabulated for all cases that were summarized. Using the data available however, selected parameters reflecting man overboard events were tabulated and analyzed according to vessel classes.

It is recognized that casualty reports for man overboard events (falls from vessel into water not involving a vessel casualty) are required only for those cases involving deaths, injuries, property damage, and other vessel-related events as previously defined. Therefore, it is probable that some man overboard events involving prompt and successful retrievals are not reported. No data were available to indicate the extent or number of these cases. Thus, the ratio of persons saved to persons lost derived from the casualty records is mainly useful for comparison purposes and does not provide an absolute measure of effectiveness for existing life saving equipment.

A summary of the results of the analysis of data from casualty records for man overboard situations is shown in Table 30. This table also lists the approximate number of vessels in service for most of the vessel classes listed. The ratio of persons lost per vessel in service should not be construed as a relative measure of personnel hazard without considering other factors such as crew size and vessel utilization.

Tables 31 through 41 are compilations of data from a somewhat fewer number of casualty cases. The data in these tables are arranged according to events associated with retrieval attempt actions and some

TABLE 30. ANALYSIS OF CASUALTY DATA - FALLS FROM VESSEL INTO WATER
(Man Overboard - No Vessel Casualty - Fiscal Years 1973, 1972, and 1971)

Events	Passenger Vessels (Small & Large)	Freight Vessels	Tanker Vessels	Barges	Fishing Vessel (Large)	Fishing Vessel (Small)	Fishing Vessel (Size Unknown)	Tugs and Towing Vessels	Platforms and Drilling Vessels	Miscellaneous Vessels	Total All Vessel Classes
Approximate Number of Vessels in Service	4,000	2,300	400	3,000+	13,000 (5 Net Tons or More) 83,000 (Total)			6,000	250 +	- -	
Number of Persons in the Water	20	57	14	27	29	26	9	45	11	28	266
Number of Persons Saved	2	16	0	1	1	0	1	5	2	2	30
Number of Persons Lost	18	41	14	26	28	26	8	40	9	26	236
Number of Persons Wearing Floatation	2	7	2	4	0	1	0	3	3	3	25
Number of Persons Wearing Floatation and Saved	0	3	0	1	0	0	0	1	1	1	7
Number of Persons Seen to Fall	14	35	6	15	15	8	3	18	8	13	135
Number of Persons Seen in Water	11	34	6	13	14	12	5	19	6	16	136
Number of Persons Missing and Presumed Overboard	3	19	7	6	8	11	3	17	3	8	85
Number of Persons that Sank Immediately Without Resurfacing	0	3	0	5	1	2	--	6	2	3	22
Number of Cases that Floatation or Life Lines Were Thrown	6	18	6	9	11	10	2	8	3	8	81
Number of Persons that Did Not Attempt to Reach Available Floatation	1	0	1	0	4	7	2	3	--	2	20
Number of Cases Involving Other Quick Rescue Attempts	10	23	5	8	12	8	3	11	4	9	93
Rescue Attempts Using Vessel (Relatively Long Time)	4	15	5	2	3	8	--	9	--	--	46
Rescue Attempts Using Vessels Small Craft (Lifeboats)	2	3	0	0	1	--	--	4	1	1	12
Rescue Attempts Using Other Vessels (Including C.G.)	5	11	4	3	4	8	--	11	3	--	49
Average Estimated Time to Drown (Minutes)	5.0	4.4	2.3	2.4	3.9	4.6	2.8	3.8	4.5	3.2	3.73
Average Estimated Time to Save (Minutes)	5.0	7.6	--	5	--	--	3	4.0	1.0	2.0	5.43
Percent Cases at Night (Not Day)	55.5	51.9	64.3	48.1	48.0	39.1	42.8	42.2	18.2	44.0	46.6
Percent Cases in Ocean (Not Inland)	33.3	78.9	100.0	18.5	96.3	65.2	42.8	28.9	100.0	45.8	58.9
Percent Cases Vessel Underway (Not Moored or Anchored)	83.3	45.6	78.6	33.3	81.5	75.0	71.4	45.0	0	20.0	51.11
Average Visibility (Miles)	8.1	8.1	8.6	7.7	8.0	7.9	6.3	7.9	7.3	7.15	7.86
Average Wind (Knots)	7.4	14.5	16.9	6.0	13.2	10.8	14.2	9.4	13.9	9.8	11.40
Average Wave Height (Feet)	1.2	4.9	5.4	0.8	3.4	2.8	2.7	2.1	7.4	1.8	3.30
Average Air Temperature (F)	61	58.1	57.3	53.1	67.7	59.9	67.5	53.9	--	53.6	57.75
Average Water Temperature (F)	59	62.9	64.7	45.9	66.5	59.5	36	49.8	--	43.4	57.16
Percent Cases From an Inspected Vessel	75	70	78.6	0	0	8.7	0	0	20	8.3	33.03
Average Vessel Age	13.1	15.6	17	6.5	7.5	29.3	15.2	21.9	--	20.7	17.71

TABLE 31. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (ALL VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED	3		1	1	2		2
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	7		7	7			
	PERSON IN WATER LOST FROM VIEW	2				2		2
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	3	1	2	3			
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER	2				2		2
	TOTAL WITH FLOATATION	17	1	10	11	6		6
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	81				81		81
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	13		10	10		3	3
	PERSON IN WATER LOST FROM VIEW	94				94		94
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	22		1	1	19	2	21
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT	10		4	4	6		6
	CONTINUED RETRIEVAL ATTEMPT - OTHER	5		3	3	2		2
	TOTAL WITHOUT FLOATATION	225		18	18	202	5	207
TOTAL		242	1	28	29	208	5	213

TABLE 32. CASUALTY DATA - FALLS FROM VESSEL INTO WATER -(LARGE PASSENGER VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED							
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW							
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITH FLOATATION	0						
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	3				3		3
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW	5				5		5
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT	1		1	1			
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITHOUT FLOATATION	8		1	1	8		8
TOTAL		8		1	1	8		8

TABLE 33. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (SMALL PASSENGER VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED							
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW							
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITH FLOATATION	0						
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	2				2		2
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW	2				2		2
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	3				3		3
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITHOUT FLOATATION	7				7		7
TOTAL		7				7		7

TABLE 34. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (FREIGHTER VESSELS)

	PERSONNEL EVENTS	TOTAL IN WATER	SAVED: LONG-TIME RETRIEVAL	SAVED: SHORT-TIME RETRIEVAL	SAVED: TOTAL SAVED	LOST: LONG-TIME RETRIEVAL	LOST: SHORT-TIME RETRIEVAL	LOST: TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED	2		1	1	1		1
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	4		4	4			
	PERSON IN WATER LOST FROM VIEW	1				1		1
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	2		2	2			
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITH FLOATATION	9		7	7	2		2
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	19				19		19
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	6		6	6			
	PERSON IN WATER LOST FROM VIEW	15				15		15
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	7				7		7
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT	2		2	2			
	CONTINUED RETRIEVAL ATTEMPT - OTHER	1		1	1			
	TOTAL WITHOUT FLOATATION	50		9	9	41		41
TOTAL		59		16	16	43		43

TABLE 35. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (TANKER VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED							
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW							
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITH FLOATATION	0						
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	6				6		6
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW	5				5		5
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	2				2		2
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITHOUT FLOATATION	13				13		13
TOTAL		13				13		13

TABLE 36. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (BARGE (CARGO) VESSELS)

	PERSONNEL EVENTS	TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED							
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	1		1	1			
	PERSON IN WATER LOST FROM VIEW							
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITH FLOATATION	1		1	1			
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	7				7		7
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	1		1	1			
	PERSON IN WATER LOST FROM VIEW	16				16		16
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	1				1		1
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITHOUT FLOATATION	25		1	1	24	0	24
	TOTAL	26		2	2	24	0	24

TABLE 37. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (LARGE FISHING VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED							
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW							
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITH FLOATATION	0						
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	7				7		7
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	1		1	1			
	PERSON IN WATER LOST FROM VIEW	12				12		12
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	4				4		4
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT	1				1		1
	CONTINUED RETRIEVAL ATTEMPT - OTHER	1				1		1
	TOTAL WITHOUT FLOATATION	26		1	1	25		25
TOTAL		26		1	1	25		25

TABLE 38. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (SMALL FISHING VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED							
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW							
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITH FLOATATION	0						
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	7				7		7
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	1					1	1
	PERSON IN WATER LOST FROM VIEW	8				8		8
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	1					1	1
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT	1				1		1
	CONTINUED RETRIEVAL ATTEMPT - OTHER	1				1		1
	TOTAL WITHOUT FLOATATION	19				17	2	19
TOTAL		19				17	2	19

TABLE 39. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (TUG/TOWBOAT VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED							
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	1		1	1			
	PERSON IN WATER LOST FROM VIEW							
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	1	1		1			
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITH FLOATATION	2	1	1	2			
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	19				19		19
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	3		1	1		2	2
	PERSON IN WATER LOST FROM VIEW	14				14		14
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	2		1	1		1	1
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT	4				4		4
	CONTINUED RETRIEVAL ATTEMPT - OTHER	2		2	2			
	TOTAL WITHOUT FLOATATION	44		4	4	37	3	40
TOTAL		46	1	5	6	37	3	40

TABLE 40. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (PLATFORM/DRILLING VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED							
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW	1				1		1
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER	1				1		1
	TOTAL WITH FLOATATION	2				2		2
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	3				3		3
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	1		1	1			
	PERSON IN WATER LOST FROM VIEW	3				3		3
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITHOUT FLOATATION	7		1	1	6		6
TOTAL		9		1	1	8		8

TABLE 41. CASUALTY DATA - FALLS FROM VESSEL INTO WATER - (MISCELLANEOUS VESSELS)

PERSONNEL EVENTS		TOTAL IN WATER	SAVED			LOST		
			LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL SAVED	LONG-TIME RETRIEVAL	SHORT-TIME RETRIEVAL	TOTAL LOST
PERSONNEL WITH FLOATATION	CASUALTY NOT OBSERVED	1				1		1
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS	1		1	1			
	PERSON IN WATER LOST FROM VIEW							
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL							
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT							
	CONTINUED RETRIEVAL ATTEMPT - OTHER	1				1		1
	TOTAL WITH FLOATATION	3		1	1	2		2
PERSONNEL WITHOUT FLOATATION	CASUALTY NOT OBSERVED	8				8		8
	INITIAL RETRIEVAL ATTEMPT SUCCEEDS							
	PERSON IN WATER LOST FROM VIEW	14				14		14
	CONTINUED RETRIEVAL ATTEMPT FROM VESSEL	2				2		2
	CONTINUED RETRIEVAL ATTEMPT FROM SMALL BOAT	1		1	1			
	CONTINUED RETRIEVAL ATTEMPT - OTHER							
	TOTAL WITHOUT FLOATATION	25		1	1	24		24
TOTAL		28		2	2	26		26

casualty cases did not include sufficient detail for use in these compilations. These tables were used to develop input parameters for the man overboard casualty profile simulations.

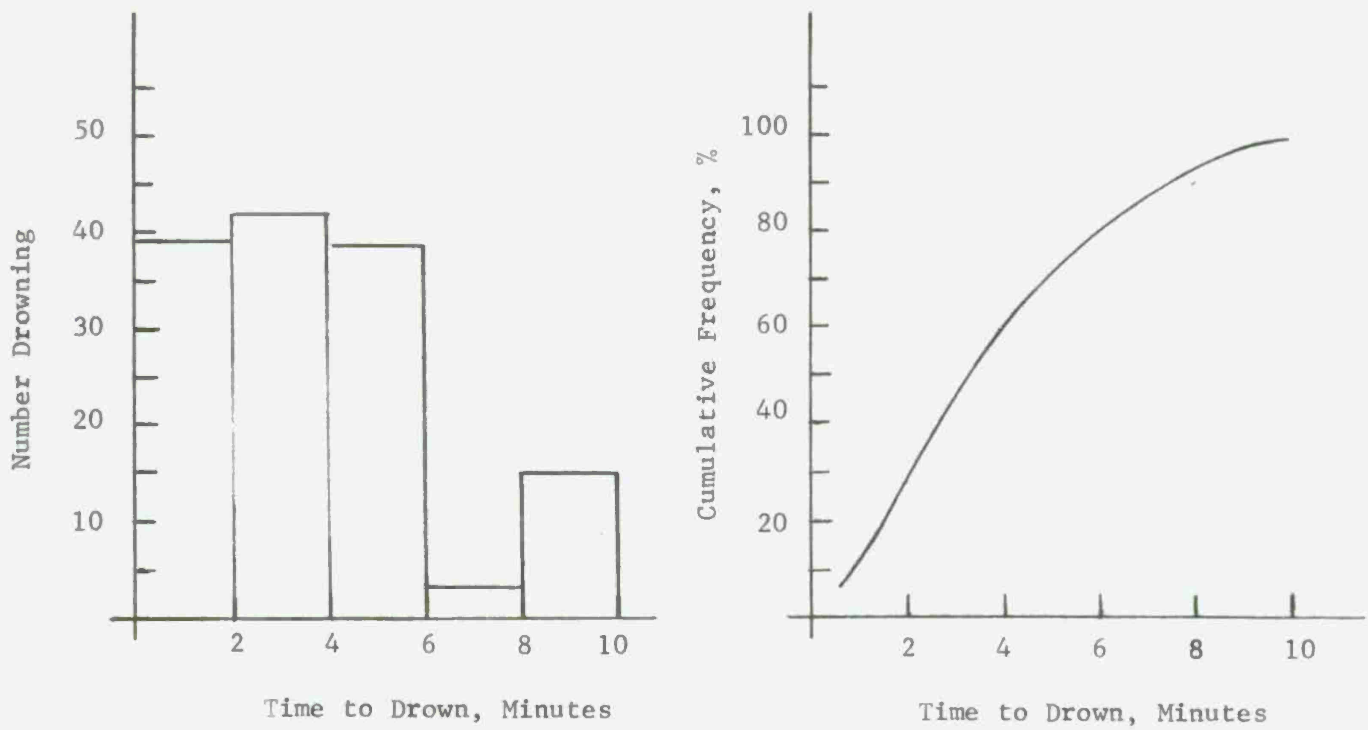
Consideration of Analysis Results

There are several significant observations that can be made based solely on the casualty analysis results for the man overboard situation.

(1) Relatively few persons lost were wearing floatation (life preservers.)

(2) The use of floatation (life preservers) improves the chance of survival but does not assure survival. Based on the data the average chance of survival for persons wearing floatation is approximately 28%. In contrast, the average chance of survival for persons not wearing floatation is 9.5%.

(3) The average time for drowning is 3.73 minutes and the average retrieval time for those saved is 5.43 minutes. These time values are based on reported times and estimates derived from the casualty accounts. A significant conclusion from these data is that man overboard retrievals must be accomplished in a very short time to significantly improve the chance of survival. The need for rapid retrieval is further illustrated by considering the relative numbers of personnel drowned in various time intervals. Figure 6 shows these relationships. The cumulative frequency histogram indicates, for example, that if retrievals could be accomplished in not more than 1 minute, then about 90% of the personnel now lost could be saved.



NOTE: Cumulative Frequency, %, may be construed to mean probability of drowning relative to time.

FIGURE 6. TIME TO DROWN HISTOGRAM FOR MAN OVERBOARD CASUALTIES - ALL VESSEL CLASSES

(4) In approximately 70% of the man overboard situations, the person involved is either seen to fall or seen in the water in a very short time. Conversely, in about 30% of the man overboard situations there is no immediate recognition that a man overboard situation exists.

(5) In about 9.3% of the persons lost cases (for all vessel classes), the person falling into the water sank immediately and did not resurface. This situation was more prevalent for barges (19.2%) although the environmental conditions for barges is generally less severe than for other vessel classes.

(6) Of the 16 persons reported saved on freight vessels, 15 or about 94% were saved when the vessels were not underway. This factor was not significant for other vessel classes.

(7) The environmental conditions generally appear as an influencing factor. Of those persons saved, only approximately 20% were saved when the winds and waves were worse than the calculated average values. More details on the apparent effect of environmental conditions are presented in another section of this report.

Reviews of the man overboard casualty cases allows the postulation of a "typical" profile for a man overboard situation. The events in such a typical profile are:

(1) Person falls from vessel into water. In most cases the person would be a crewman who falls from the vessel deck. Also, in most cases the person would not be wearing a life preserver. About 50% of the cases would occur at night, about 50% of the cases would occur at ocean locations, and about 50% of the cases would occur with the vessel underway.

(2) Alarm sounded and initial attempt is made to retrieve the person in the water. The initial retrieval attempt may include throwing life rings or life lines toward the person in the water. Other types of initial retrieval attempts include rapid maneuvering of the vessel so that persons on board can reach or extend available equipment to the person in the water or entry of a swimmer into the water. In a few cases, the person in the water may have been able to save himself by swimming to another vessel or to shore.

(3) If the initial relatively rapid retrieval attempt is not successful then a continuing effort would be carried out. This continuing effort generally would include requests for assistance from public sources or from other vessels, further maneuvering of the vessel to attempt to reach the person in the water, and in a few cases launching of the vessels lifeboat or other small craft. Unfortunately, by the time these efforts can be activated, the person in the water will probably have drowned and the retrieval will be unsuccessful.

Casualty Environment

The environmental conditions associated with vessel casualties resulting in abandonment and man-overboard casualties were analyzed in some detail to provide guidelines for use in establishing survival system functional requirements. Unfortunately, not all casualty case records include environmental data, therefore, for some vessel classes, very sparse information was available.

Table 42 provides a listing of wind, wave, air, and water temperature conditions arranged according to vessel classes and casualty types. The data listed include average, extreme values, and a 90th percentile value that is not expected to be exceeded in 90 percent of the cases. This 90th percentile value was estimated from cumulative frequency histograms that were prepared for all vessel classes and casualty types listed.

Figures 7 through 30 are selected examples of the histograms that were prepared. For vessel casualties resulting in abandonment, histograms were prepared for environmental conditions encountered for (1) all vessel classes, (2) freighters and tankers, and (3) tugs and barges. For example, Figure 7 illustrates the number of cases for which wind velocities of 0 to 20, 20 to 40, and 40 to 60 knots, etc., were encountered. These data are accumulated from all vessel classes and represent a composite of the environments of all vessel classes.

From the vessel casualty data analysis it was found that some vessel classes are predominantly associated with ocean areas and some are mainly associated with inland areas. To illustrate these differences in environments, histograms are shown of the environmental conditions encountered by freighters and tankers (mainly ocean areas) and tugs and barges (mainly inland areas).

These histograms indicate that in an ocean environment (freighters and tankers) the expected value of highest wind velocity for 90 percent of vessel abandonment cases is about 56 knots, for an inland environment (tugs and barges) about 41 knots, and for the composite of all vessel

TABLE 42. ENVIRONMENTAL DATA ASSOCIATED WITH CASUALTY EVENTS

EVENT AND VESSEL CLASS	MEAN VALUE, WORST CASE VALUE, ESTIMATED 90TH PERCENTILE			
	WIND (knots)	WAVES (feet)	AIR TEMP. (F)	WATER TEMP. (F)
Abandon Ship Miscellaneous Vessels	18.1 55 37	6.0 20 15	60.8 30 42	66.1 52 45
Abandon Ship Freight Vessel	31.8 180 55	9.69 40 32	54.9 30 35	49.5 -- * -- *
Abandon Ship Platform/Drilling	19.3 72 55	4.1 20 -- *	-- * -- * -- *	81.3 -- * -- *
Abandon Ship Fishing Vessel (Large)	20.6 70 48	6.2 30 15	55.3 5 30	50.7 33 34
Abandon Ship Fishing Vessel (Small)	23.2 160 55	6.2 40 13	56.2 0 37	55.8 32 39
Abandon Ship Tug/Towboat	15.9 60 40	3.5 30 11	64.1 10 45	50 -- * -- *
Abandon Ship Passenger Vessel	10.2 35 20	3.4 20 10	69.4 26 50	65.9 40 48
Abandon Ship Tanker	24.7 65 56	8.9 40 36	62.8 -- * -- *	61.5 -- * -- *

* Insufficient data.

TABLE 42. CASUALTY DATA - ENVIRONMENTAL DATA ASSOCIATED WITH CASUALTY EVENTS (Continued)

EVENT AND VESSEL CLASS	MEAN VALUE, WORST CASE VALUE, ESTIMATED 90TH PERCENTILE			
	WIND (Knots)	WAVES (Feet)	AIR TEMP. (F)	WATER TEMP. (F)
Man Overboard Tug/Towboat	7.8 35 26	2.2 20 6.5	54 14 28	49.8 34 36
Man Overboard Platform/Drilling Vessels	13.9 25 24	7.4 12 11	*	*
Man Overboard Fishing Vessel	12.9 35 24	3.0 10 8	65.2 30 45	61.6 30 42
Man Overboard Tanker	16.9 50 35	5.4 15 12	57.3 10 12	64.7 30 37
Man Overboard Barge	6.0 30 16	.8 6 4	53.1 25 28	45.9 31 37
Man Overboard Freight Vessel	14.5 55 27	4.9 40 12	58.1 31 33	62.9 32 43
Man Overboard Passenger Vessels	7.4 30 22	1.2 6 4	61.0 40 43	*
Miscellaneous Vessels	9.8 31 21	1.8 8 8	53.6 20 24	43.4 30 32

* Insufficient Data

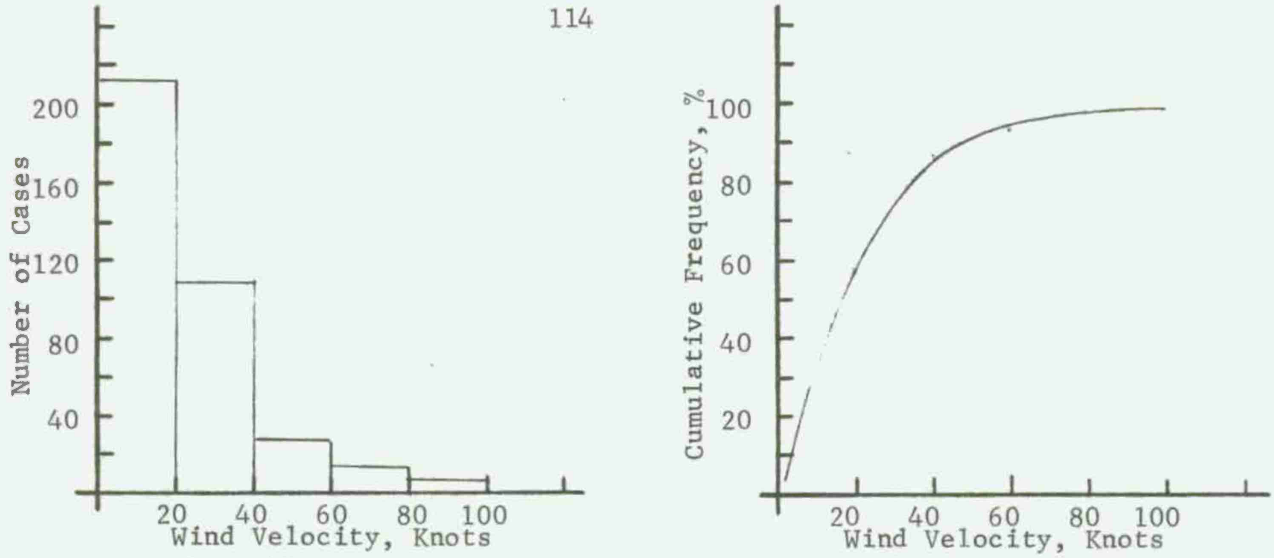


FIGURE 7. WIND VELOCITY HISTOGRAM--ABANDONMENT--ALL VESSEL CLASSES

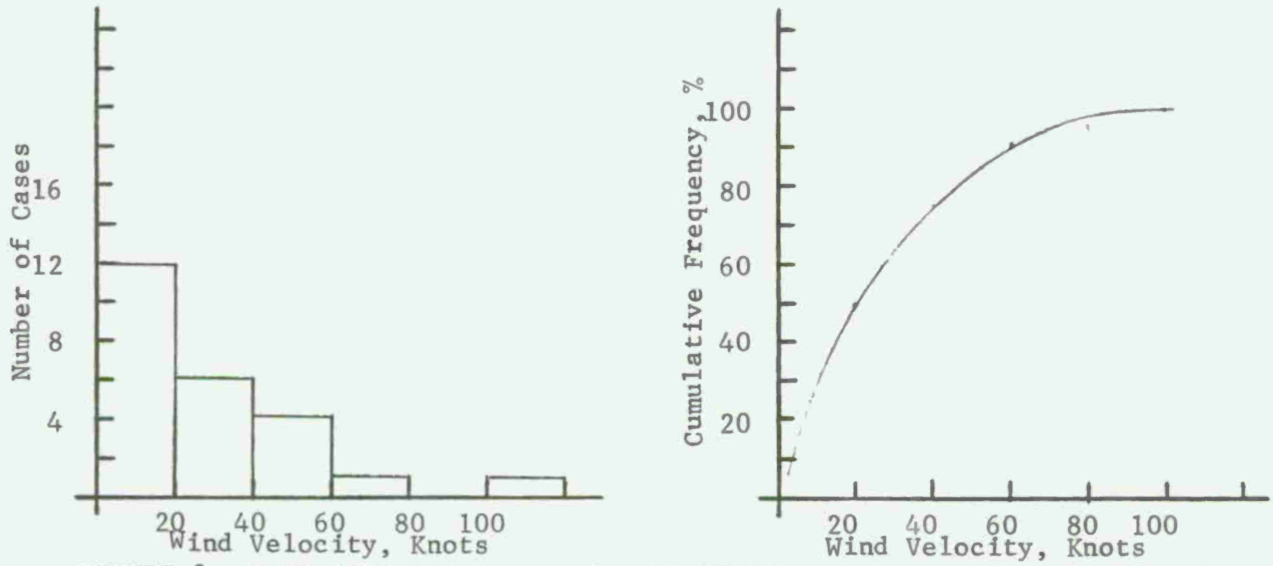


FIGURE 8. WIND VELOCITY HISTOGRAM--ABANDONMENT--FREIGHTERS AND TANKERS

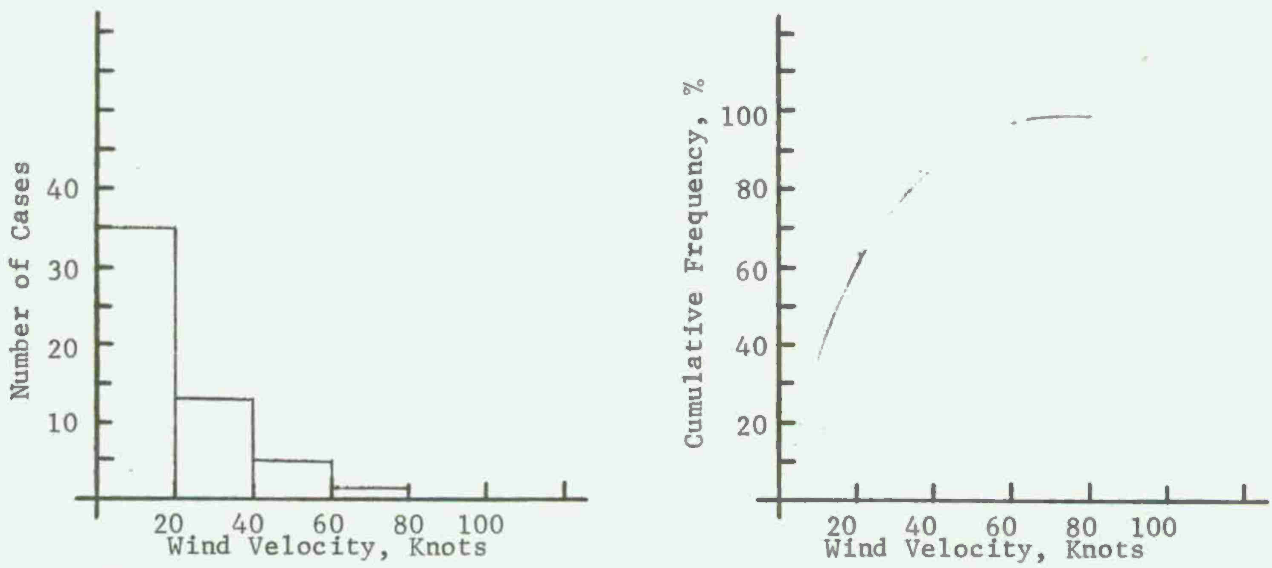


FIGURE 9. WIND VELOCITY HISTOGRAM--ABANDONMENT--TUGS AND BARGES

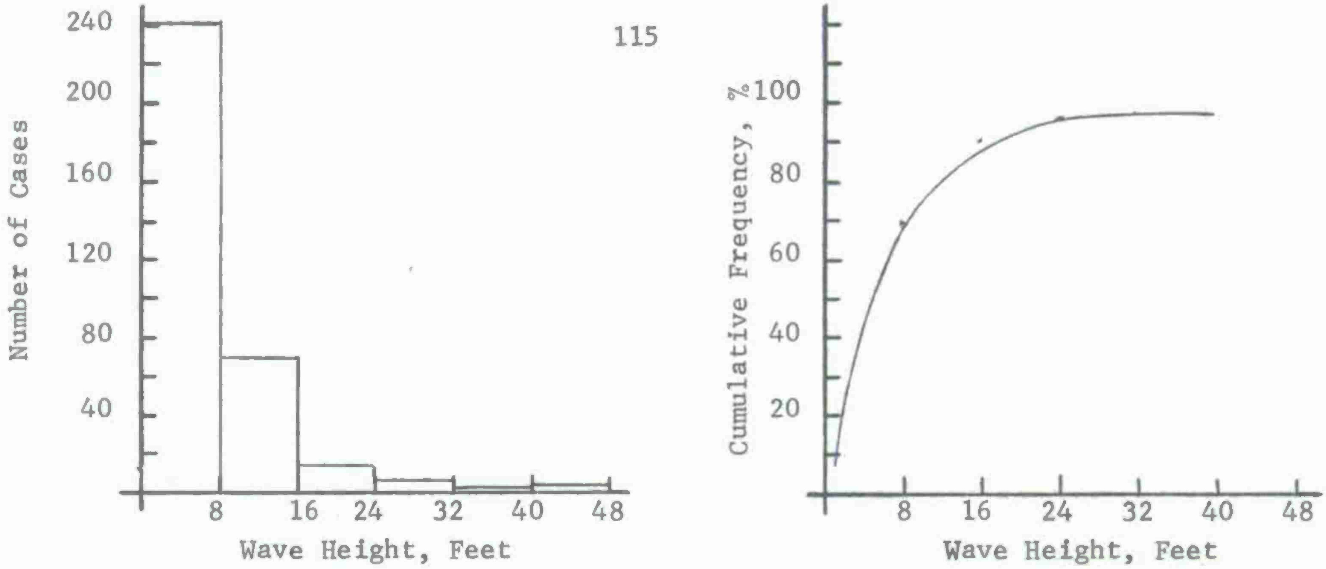


FIGURE 10. WAVE HEIGHT HISTOGRAM--ABANDONMENT--ALL VESSEL CLASSES

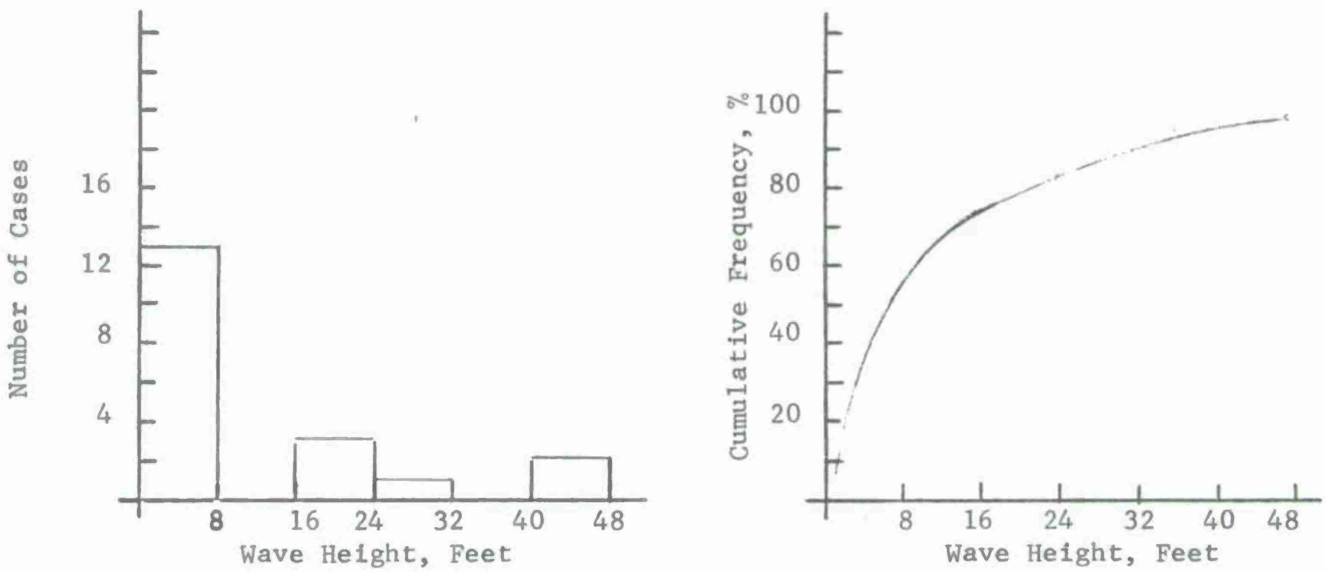


FIGURE 11. WAVE HEIGHT HISTOGRAM--ABANDONMENT--FREIGHTERS AND TANKERS

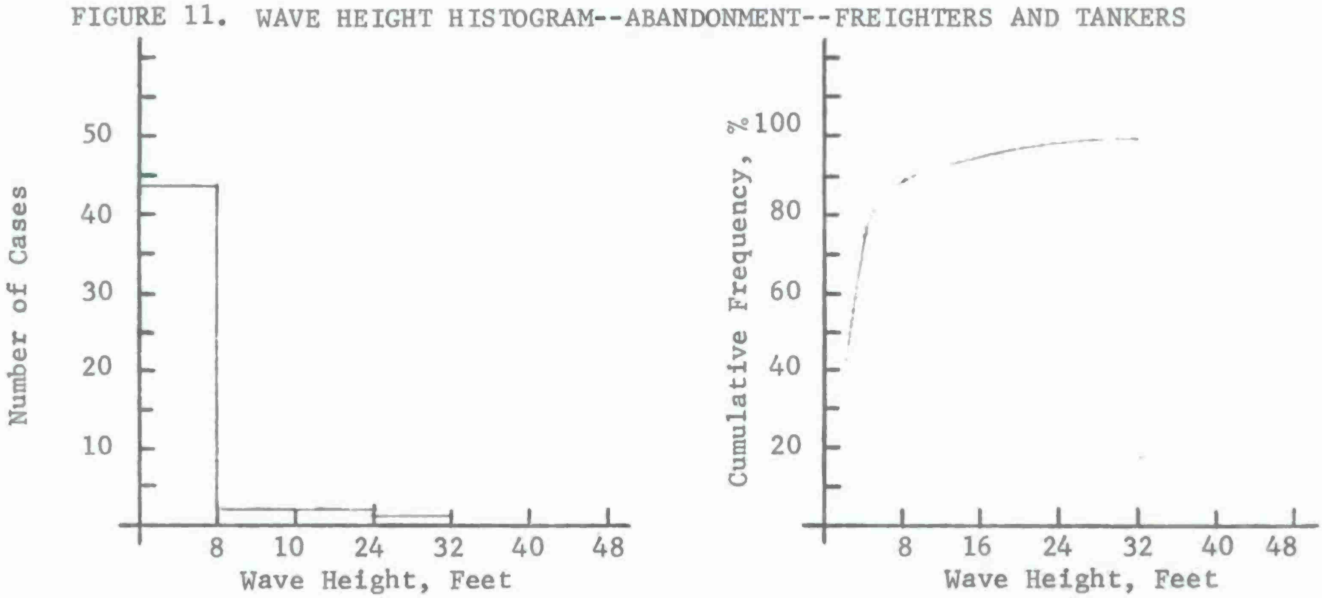


FIGURE 12. WAVE HEIGHT HISTOGRAM--ABANDONMENT--TUGS AND BARGES

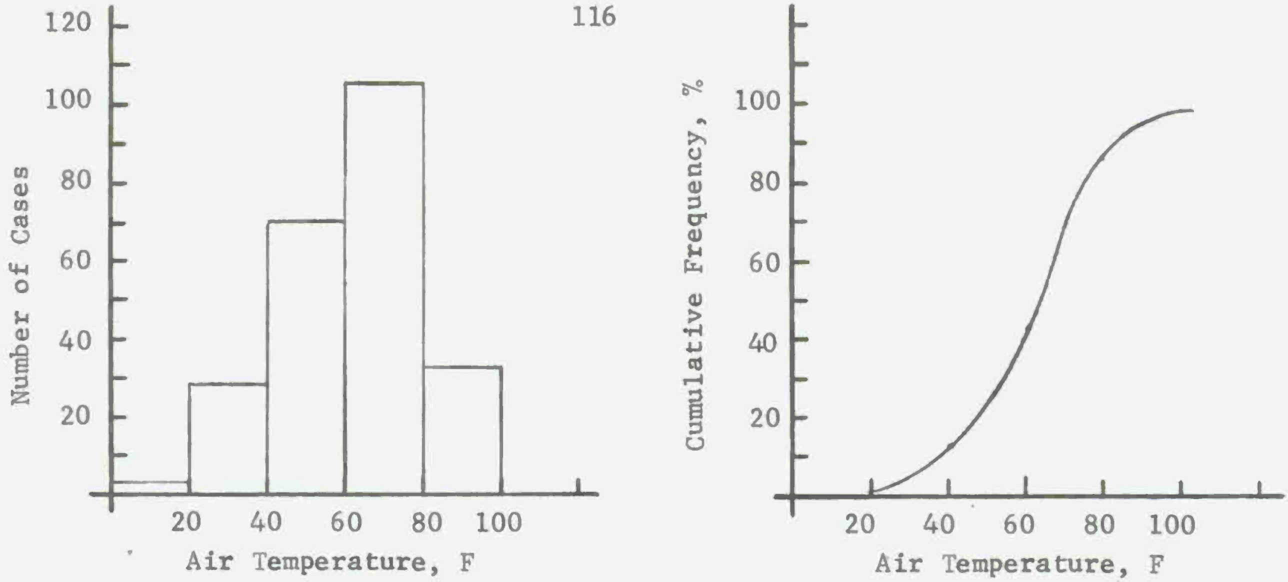


FIGURE 13. AIR TEMPERATURE HISTOGRAM--ABANDONMENT--ALL VESSEL CLASSES

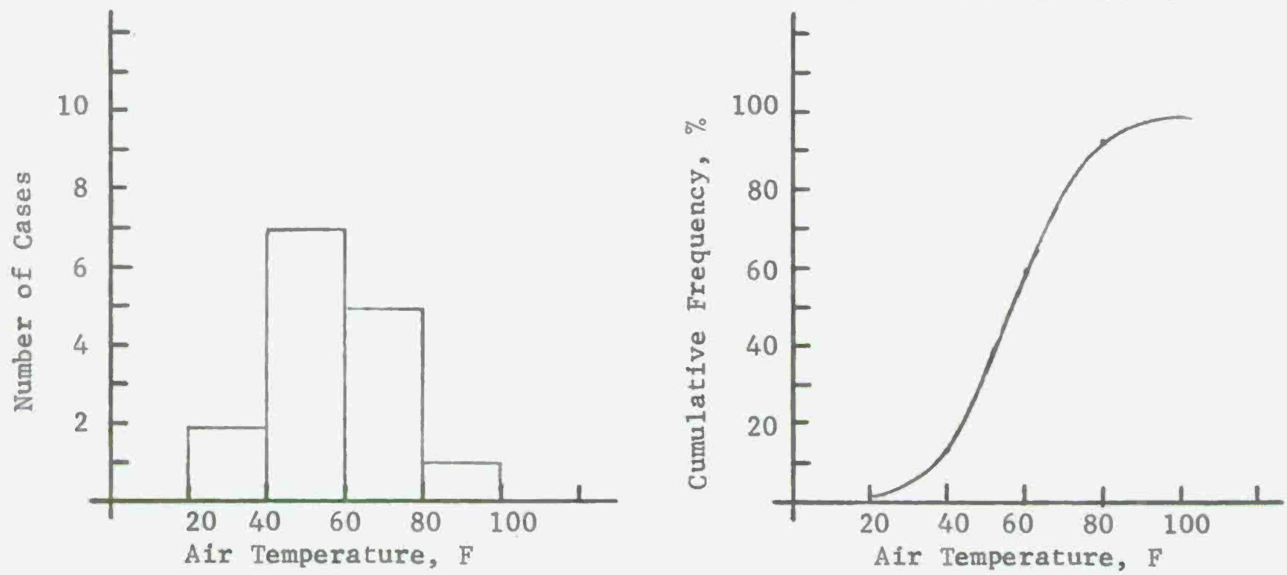


FIGURE 14. AIR TEMPERATURE HISTOGRAM--ABANDONMENT--FREIGHTERS AND TANKERS

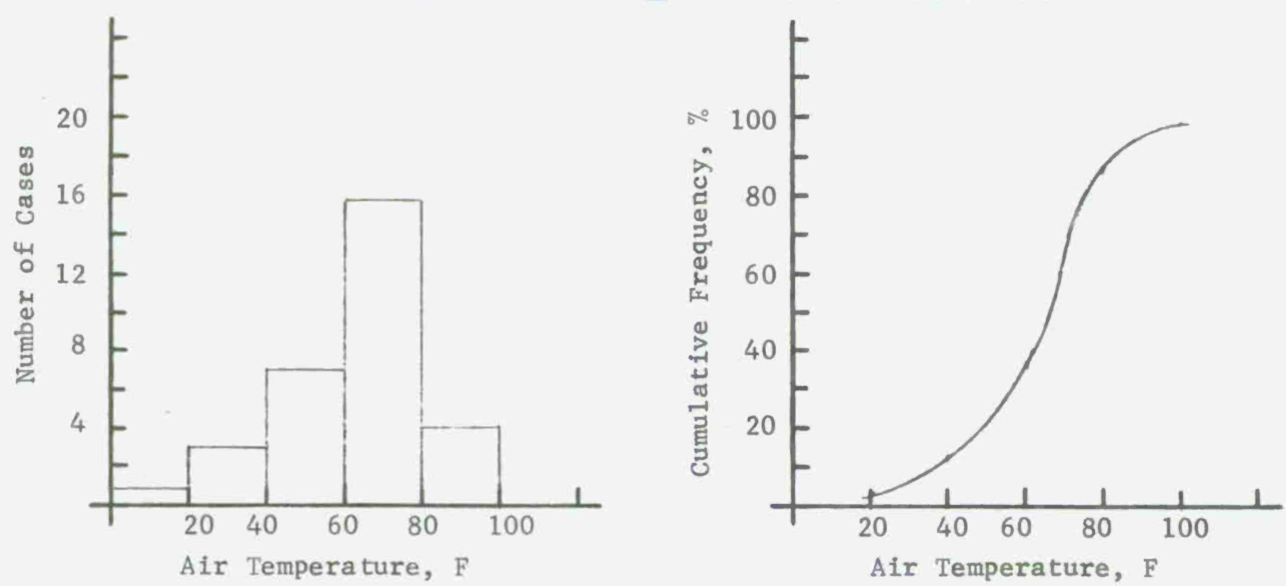


FIGURE 15. AIR TEMPERATURE HISTOGRAM--ABANDONMENT--TUGS AND BARGES

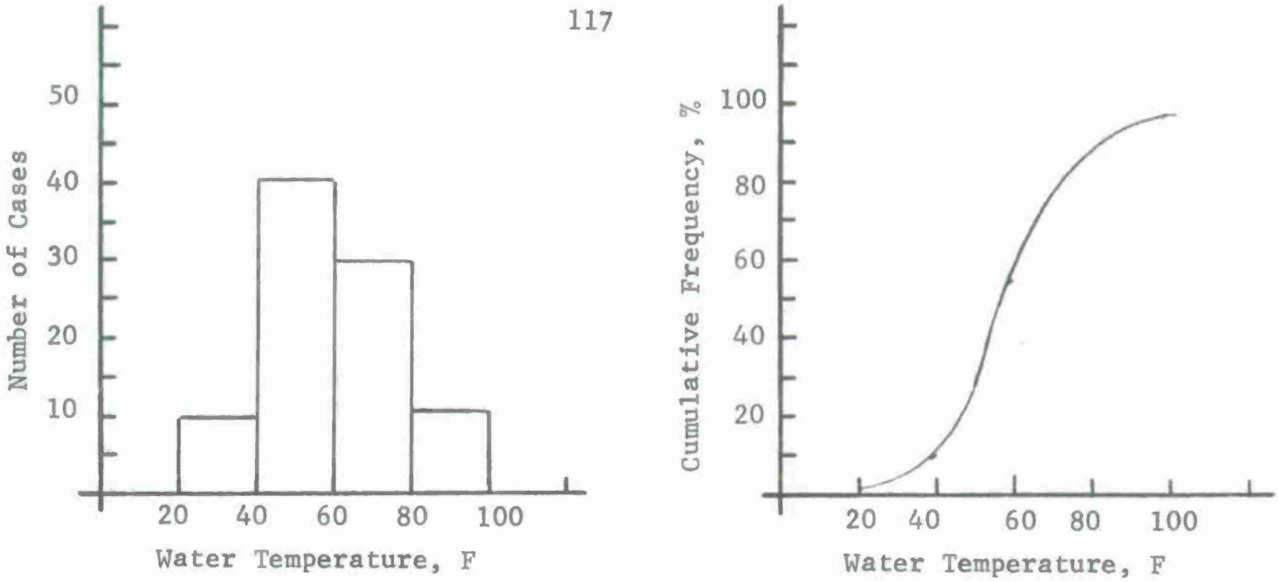


FIGURE 16. WATER TEMPERATURE HISTOGRAM--ABANDONMENT--ALL VESSEL CLASSES

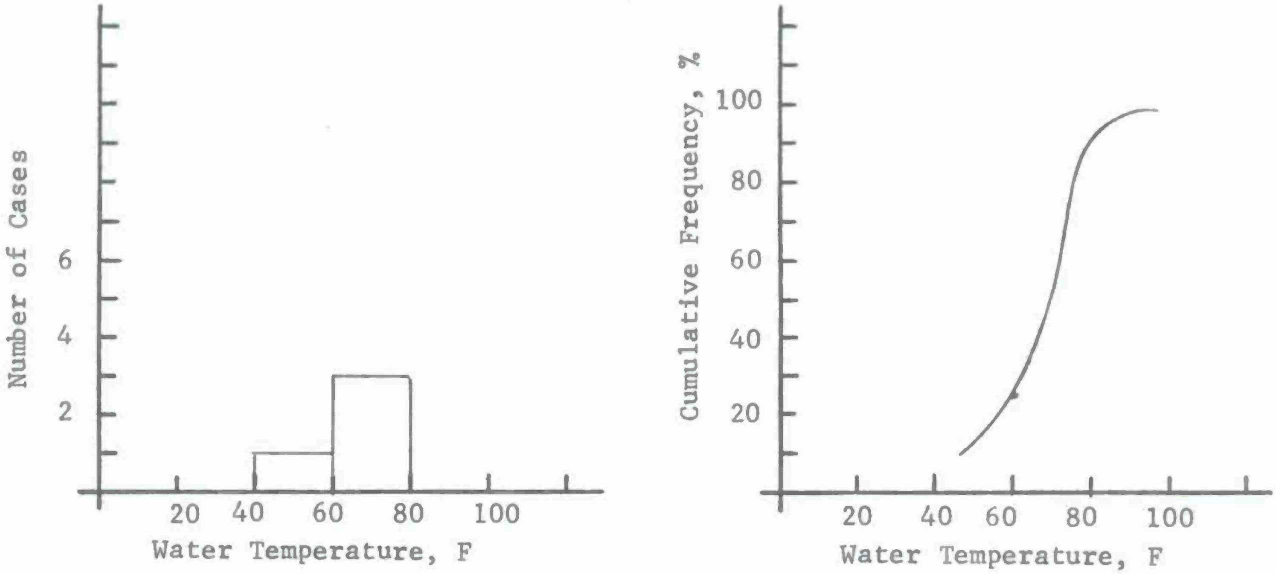


FIGURE 17. WATER TEMPERATURE HISTOGRAM--ABANDONMENT--FREIGHTERS AND TANKERS

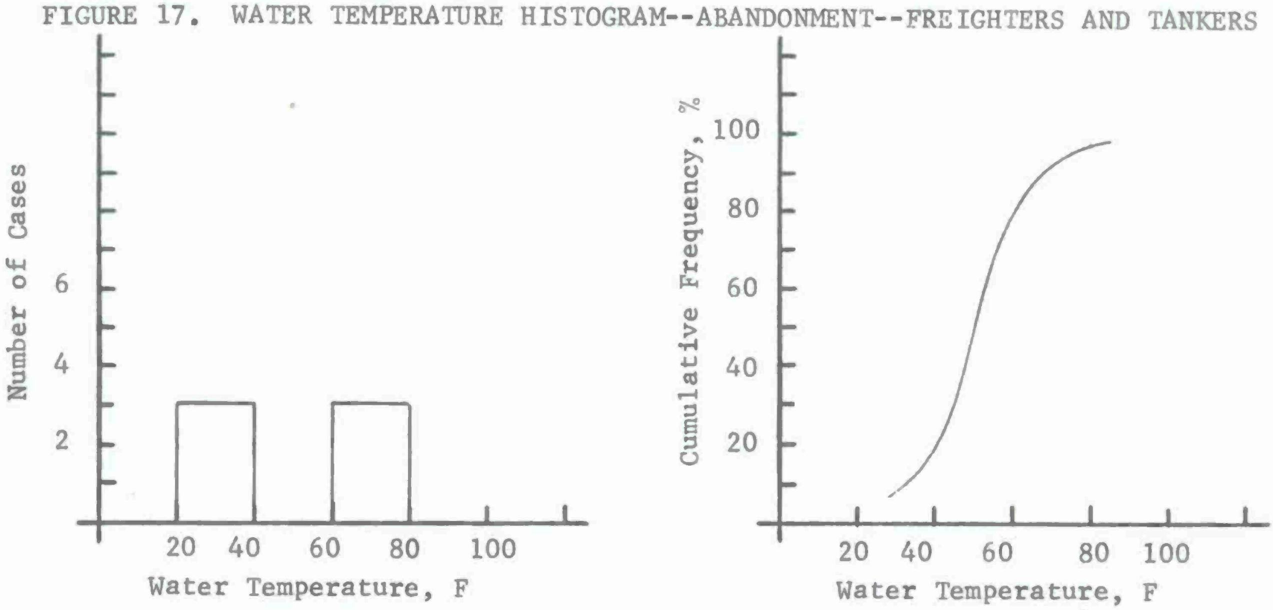


FIGURE 18. WATER TEMPERATURE HISTOGRAM--ABANDONMENT--TUGS AND BARGES

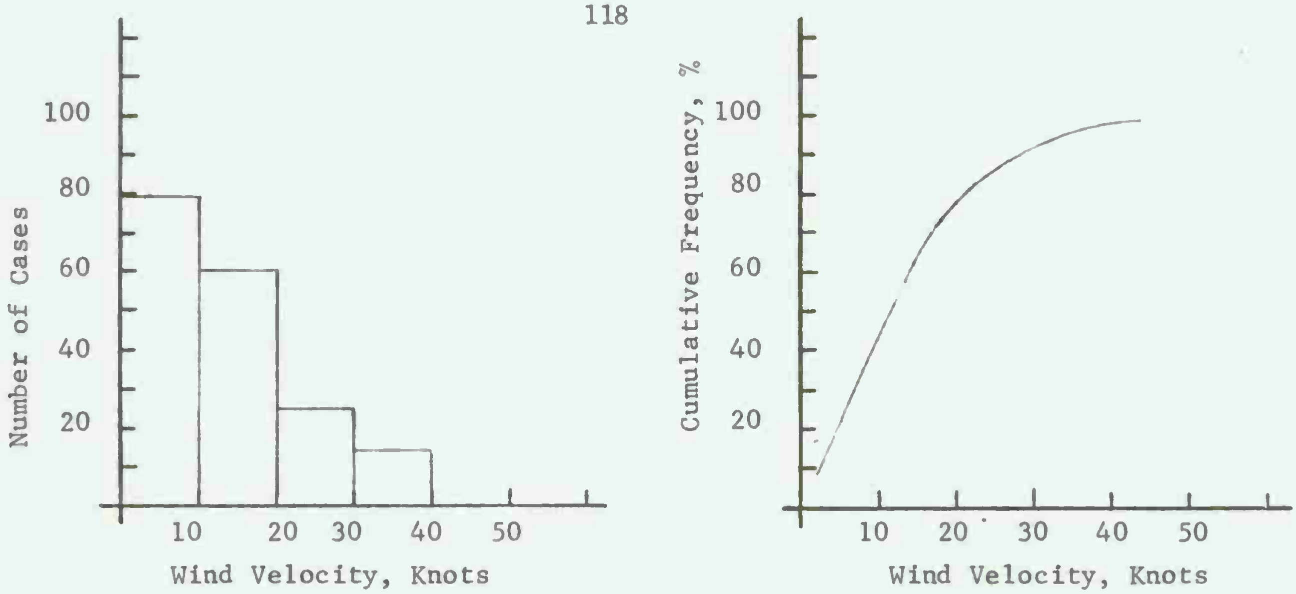


FIGURE 19. WIND VELOCITY HISTOGRAM-MAN OVERBOARD-ALL VESSEL CLASSES

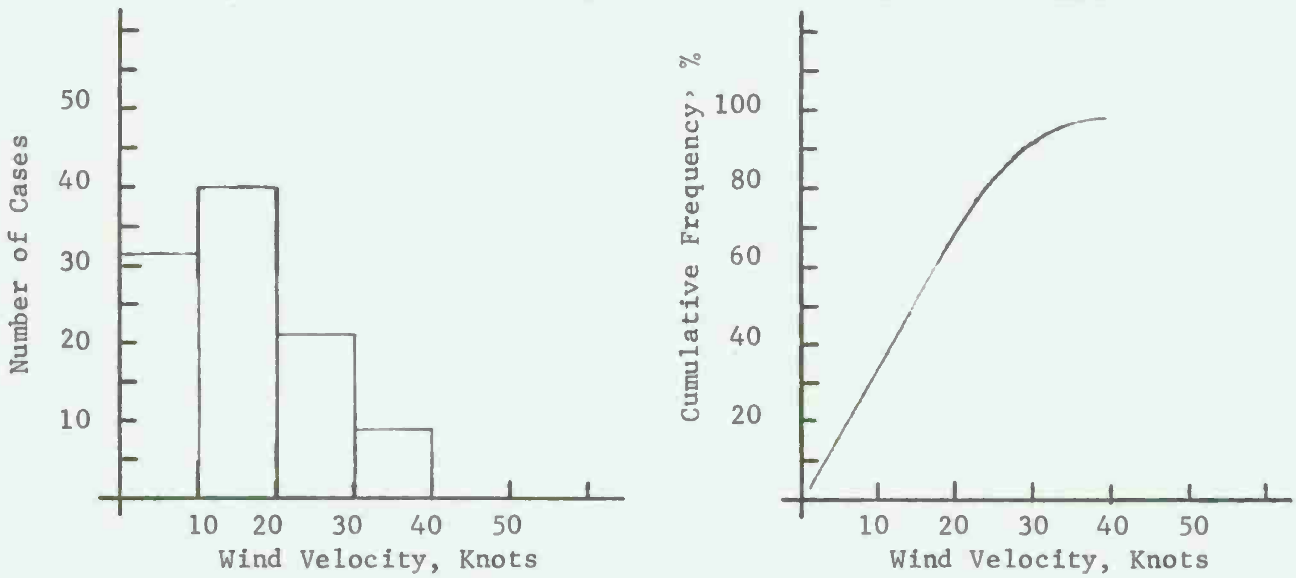


FIGURE 20. WIND VELOCITY HISTOGRAM-MAN OVERBOARD-OCEAN ENVIRONMENT

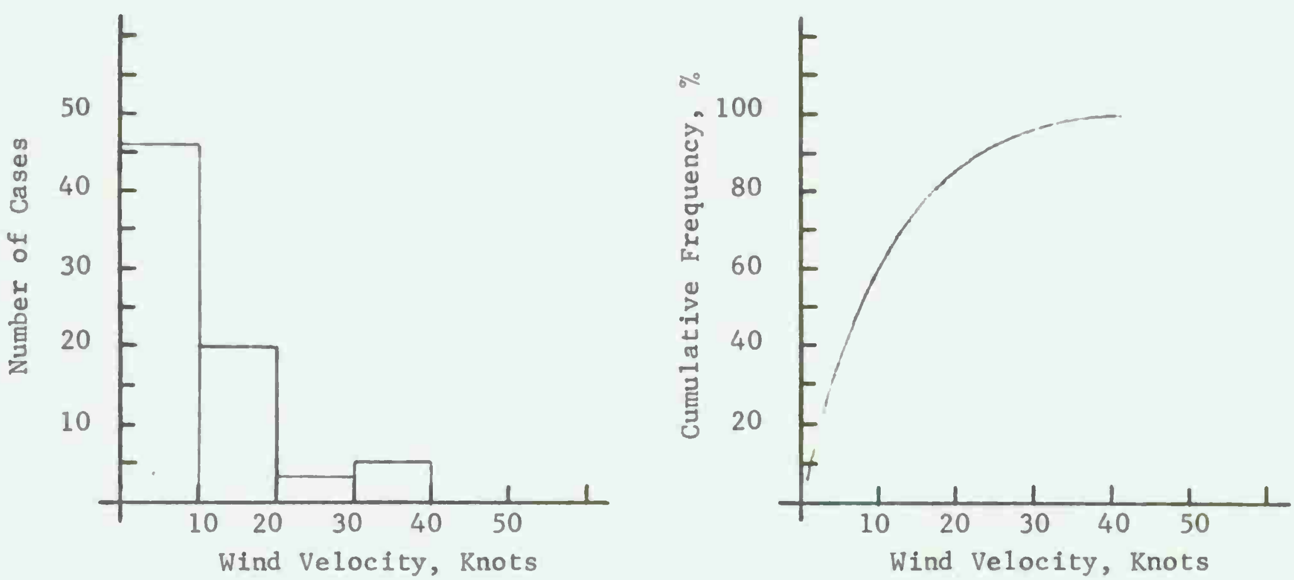


FIGURE 21. WIND VELOCITY HISTOGRAM-MAN OVERBOARD-INLAND ENVIRONMENT

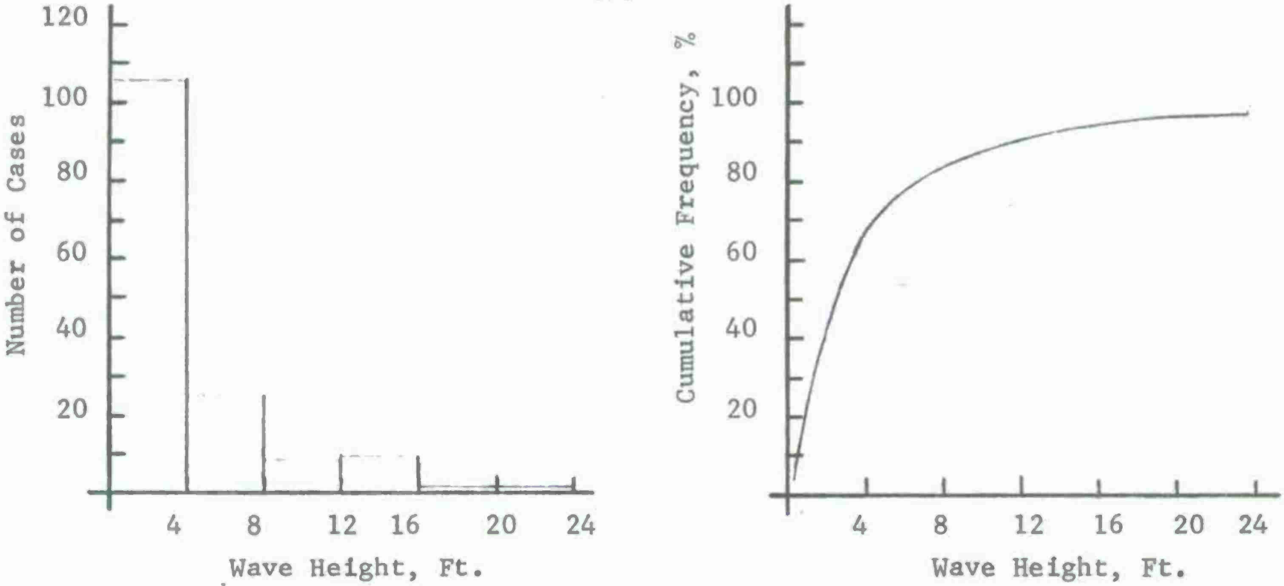


FIGURE 22. WAVE HEIGHT HISTOGRAM-MAN OVERBOARD-ALL VESSEL CLASSES

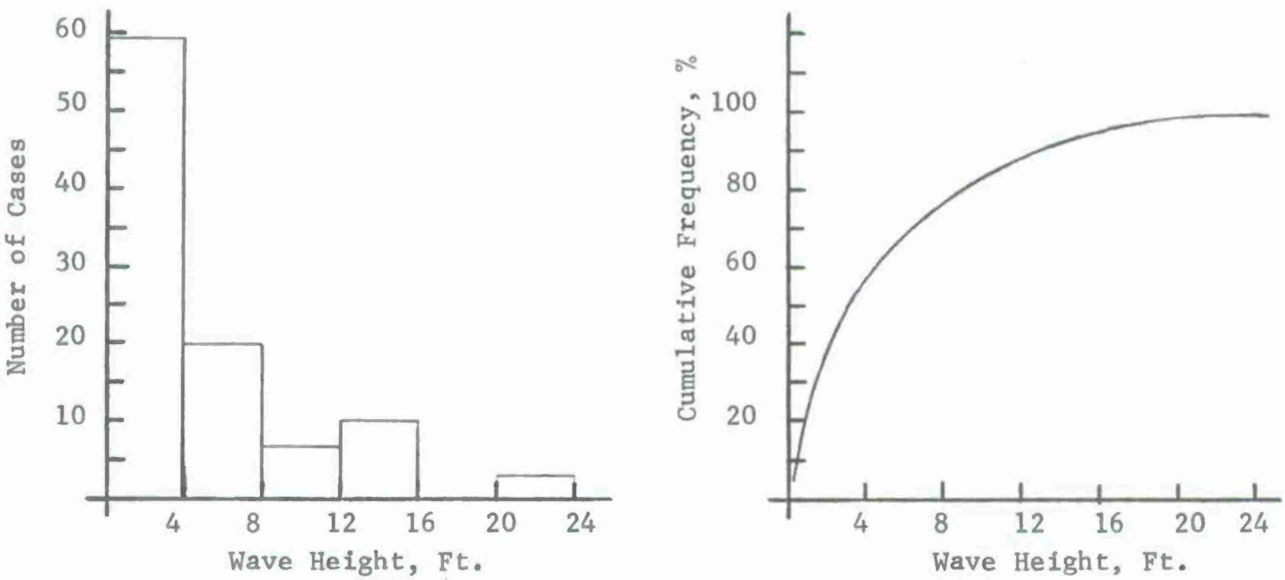


FIGURE 23. WAVE HEIGHT HISTOGRAM-MAN OVERBOARD-OCEAN ENVIRONMENT

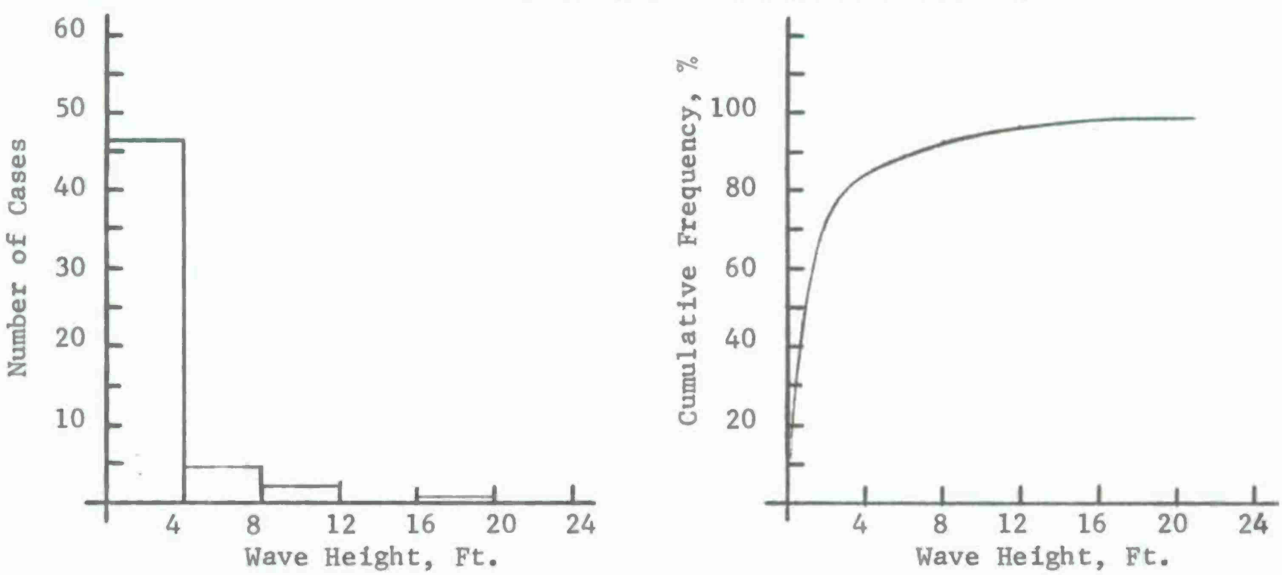


FIGURE 24. WAVE HEIGHT HISTOGRAM-MAN OVERBOARD-INLAND ENVIRONMENT

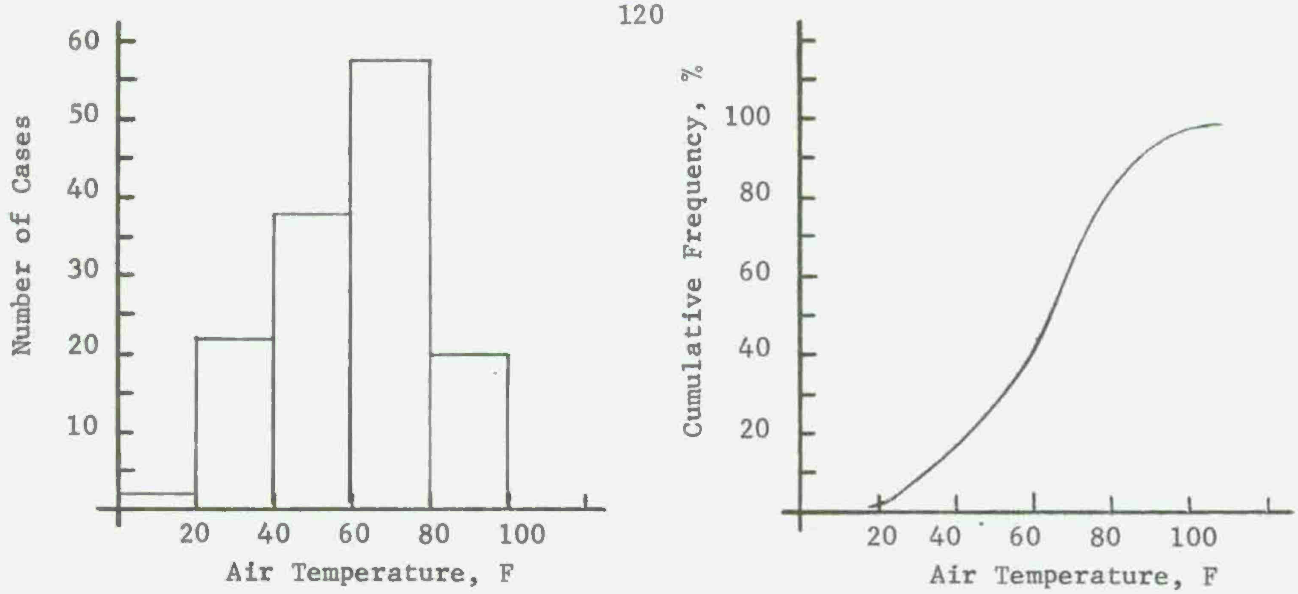


FIGURE 25. AIR TEMPERATURE HISTOGRAM-MAN OVERBOARD-ALL VESSEL CLASSES

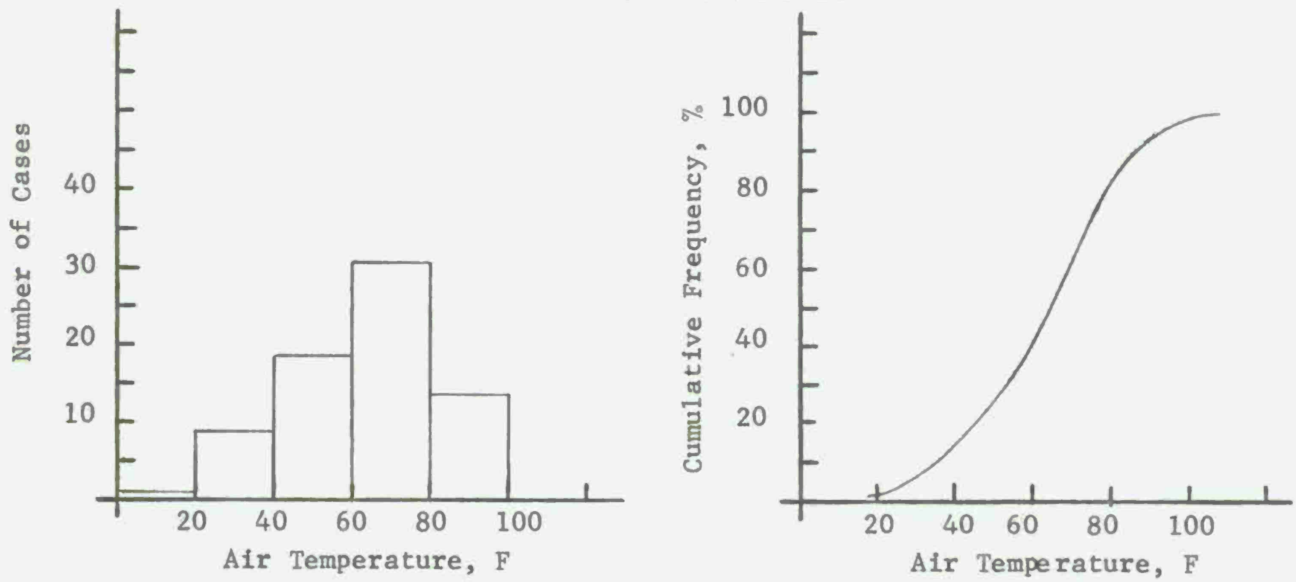


FIGURE 26. AIR TEMPERATURE HISTOGRAM-MAN OVERBOARD-OCEAN ENVIRONMENT

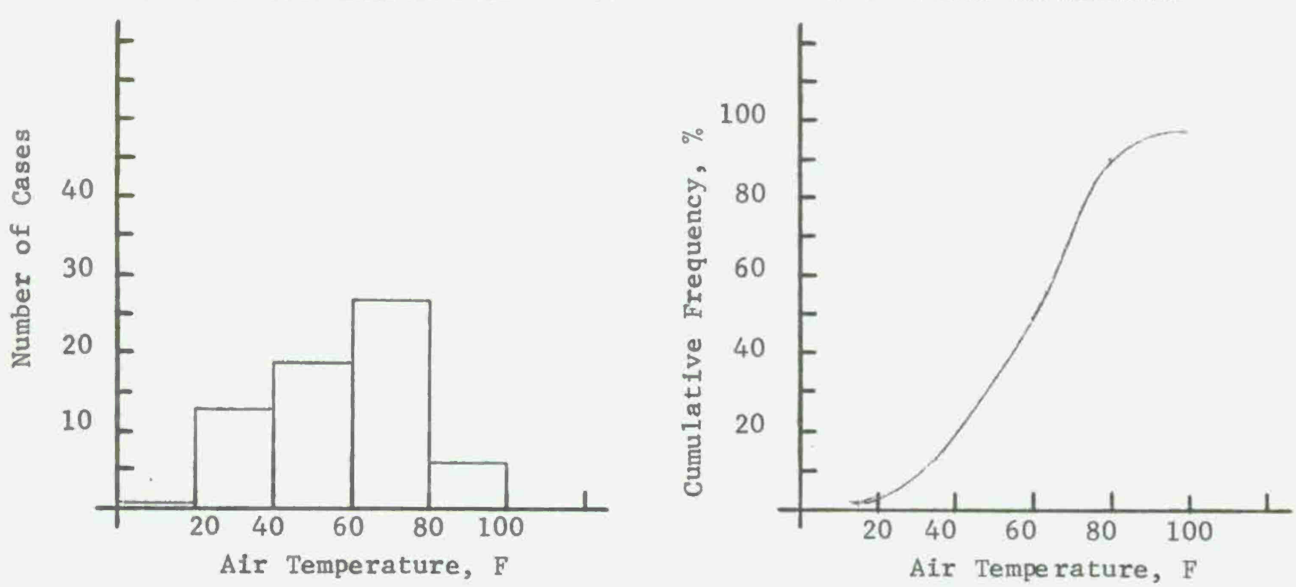


FIGURE 27. AIR TEMPERATURE HISTOGRAM-MAN OVERBOARD-INLAND ENVIRONMENT

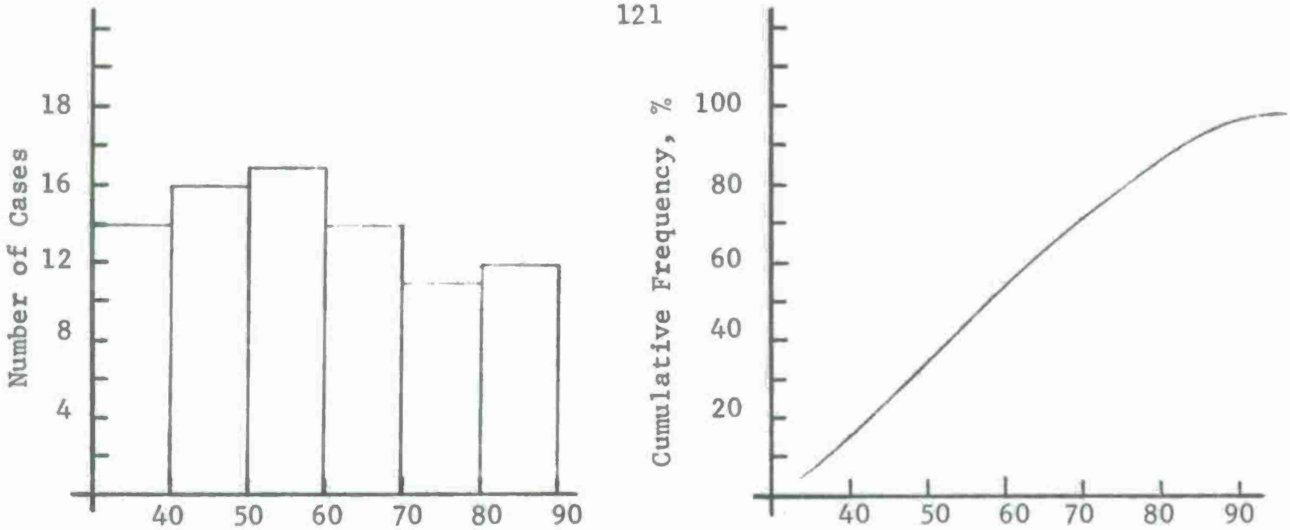


FIGURE 28. WATER TEMPERATURE HISTOGRAM-MAN OVERBOARD-ALL VESSEL CLASSES

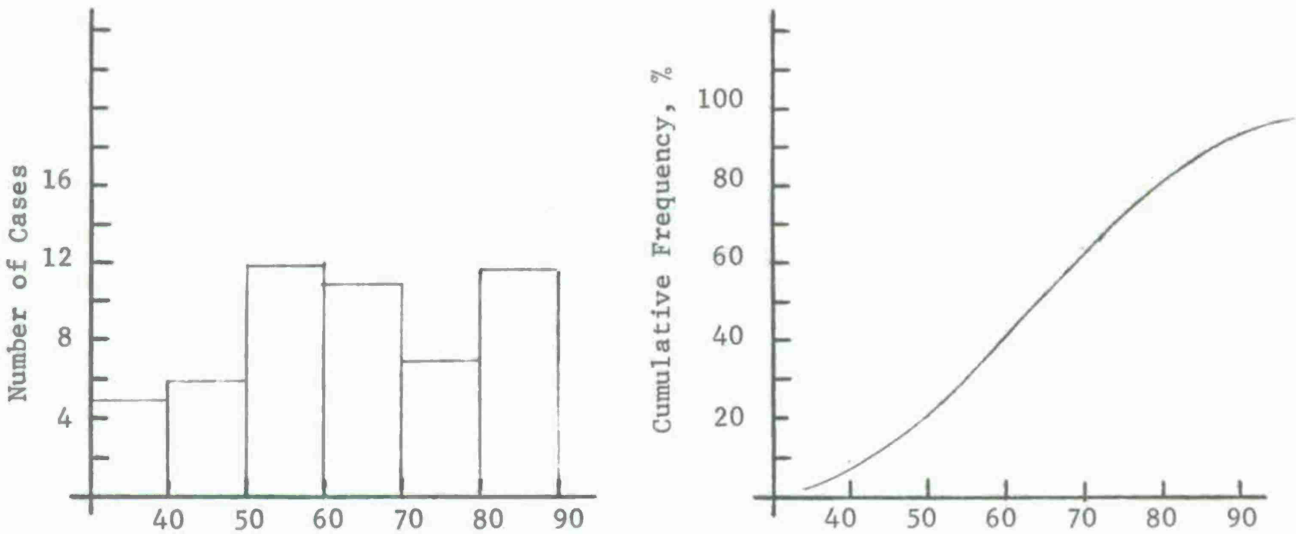


FIGURE 29. WATER TEMPERATURE HISTOGRAM-MAN OVERBOARD-OCEAN ENVIRONMENT

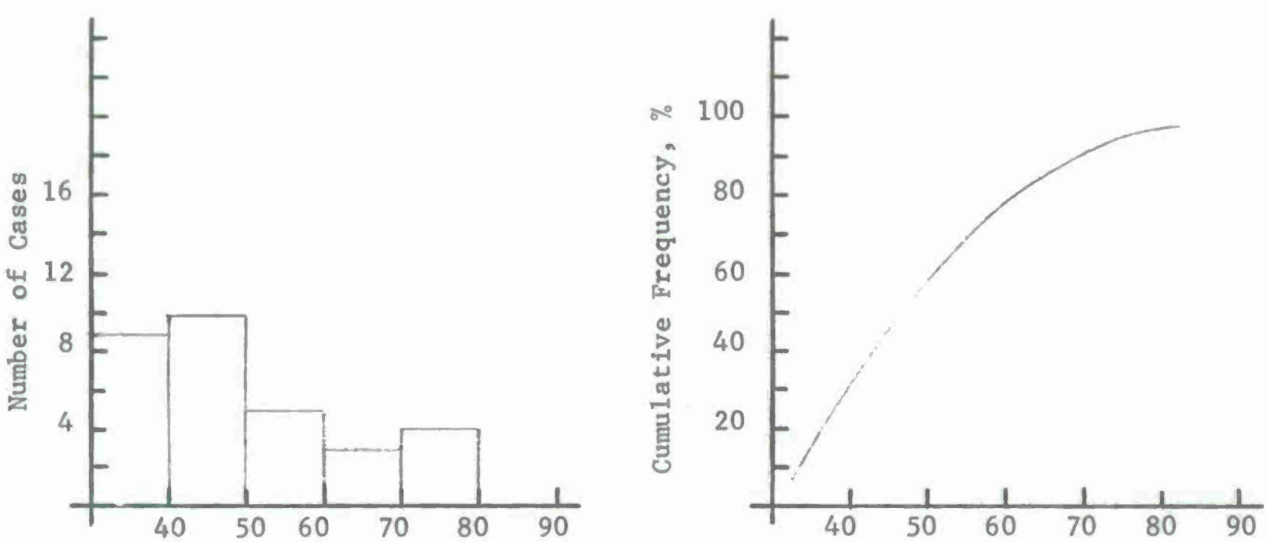


FIGURE 30. WATER TEMPERATURE HISTOGRAM-MAN OVERBOARD-INLAND ENVIRONMENT

abandonment areas about 47 knots. Similarily, the expected value of highest wave heights for 90 percent of abandonment cases in an ocean environment (freighters and tankers) is 36 feet, for an inland environment (tugs and barges) about 10 feet, and for the composite of all abandonment areas about 15 feet.

The temperature histograms generally indicate a somewhat skewed normal distribution around average values of about 59F for air and 57 F for water. Corresponding 90th percentile values are about 36 F for air and 38 F for water. Vessel casualties in ocean areas are associated with slightly warmer water temperatures and slightly cooler air temperatures. Temperature data were not available in sufficient numbers of cases to provide firm conclusions on temperature differences.

For man-overboard casualties, histograms of environmental data for freight, tanker, fishing, offshore platforms and drilling vessels were selected as representative of ocean environments and other vessel classes as representative of inland environments. For the man-overboard situation, it was found that higher wind velocities and greater wave height were encountered more frequently in ocean environments. For example the highest expected value of wind velocity for 90 percent of man-overboard cases in an inland area was found to be about 24 knots, for ocean areas about 30 knots and for the composite of all man-overboard cases was about 27 knots. Similarily, the highest expected value of wave heights for 90 percent of man-overboard cases in an inland area was found to be about 5-1/2 feet, for ocean areas about 11 feet, and for the composite of all man-overboard cases was about 10 feet.

The temperature histograms associated with man-overboard casualties indicate roughly a skewed normal distribution around an average value of about 58 F for air and an approximately uniform distribution with an average value of about 57 F for water. Corresponding 90th percentile values are about 32 F for air and 35 F for water. Air temperatures for ocean environments averaged about 60 F and air temperatures for inland environments averaged about 55 F. Water temperatures for ocean environments averaged about 63 F and water temperatures for inland environments were lower with an average of about 48 F.

For all casualty types (involving vessel abandonment and man-overboard situations) the "average" weather conditions do not appear to provide significant restraints on survival system equipment functional requirements. The extreme weather conditions reported (for example 180 knot wind) appear to impose nearly impossible restraints. It is suggested that the arbitrarily selected 90th percentile conditions be considered as minimum restraints on survival system functional requirements.

8.3 Fault-Tree Analysis

To aid in constructing network diagrams for simulation of casualties and to assist in data analysis, attempts were made to construct fault-tree logic diagrams that would be representative of events described in the casualty records. Several fault-tree diagrams were prepared and typical ones are shown in Figures 31 through 36. The results of these diagrams were used to aid in making probabilistic calculations for use in the casualty simulations; however, after logic patterns were established, it was found that the fault-tree representation tended to duplicate the casualty-simulation networks.

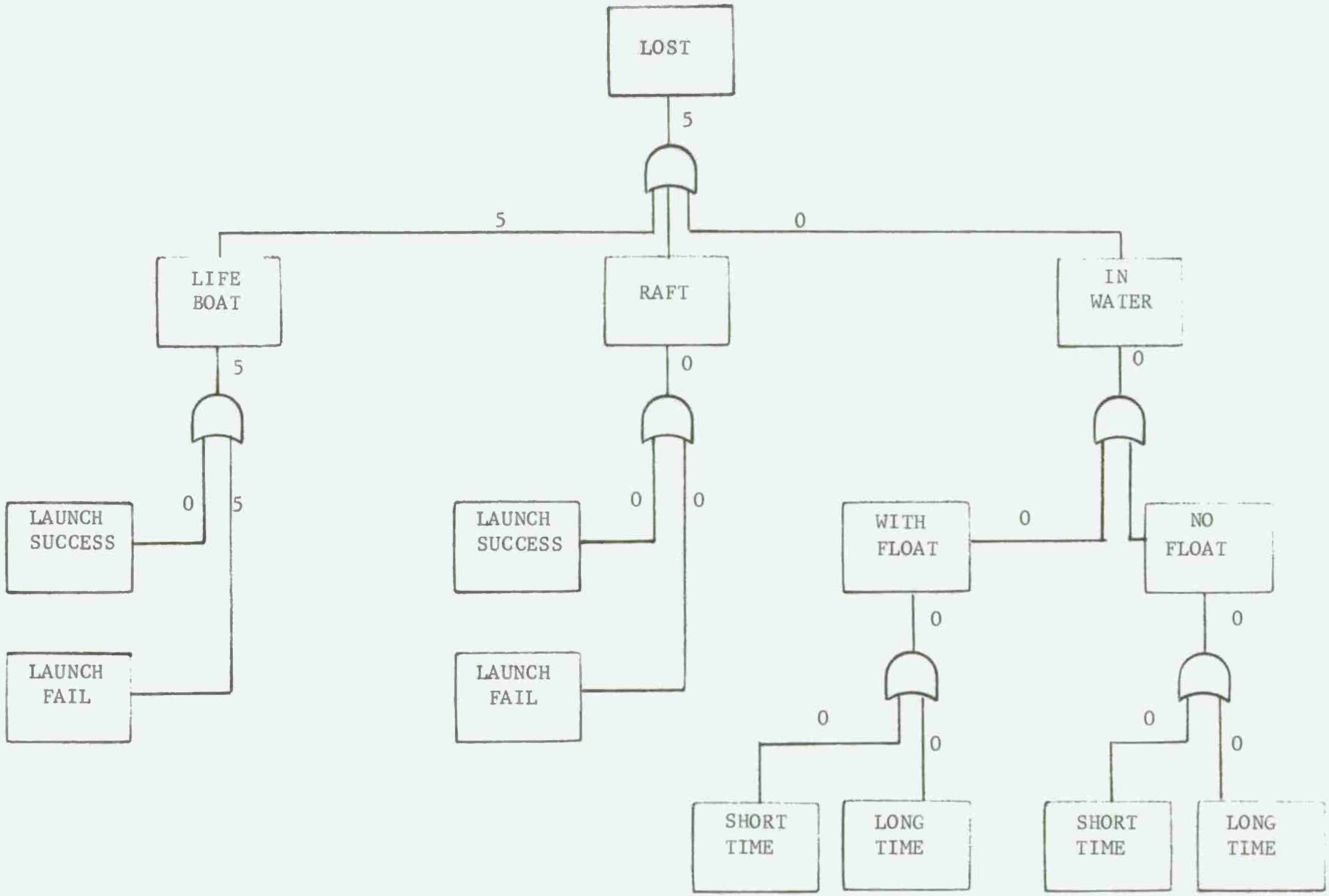


FIGURE 31. FAULT-TREE DIAGRAM
FREIGHT VESSEL ABANDONMENT (LOST)

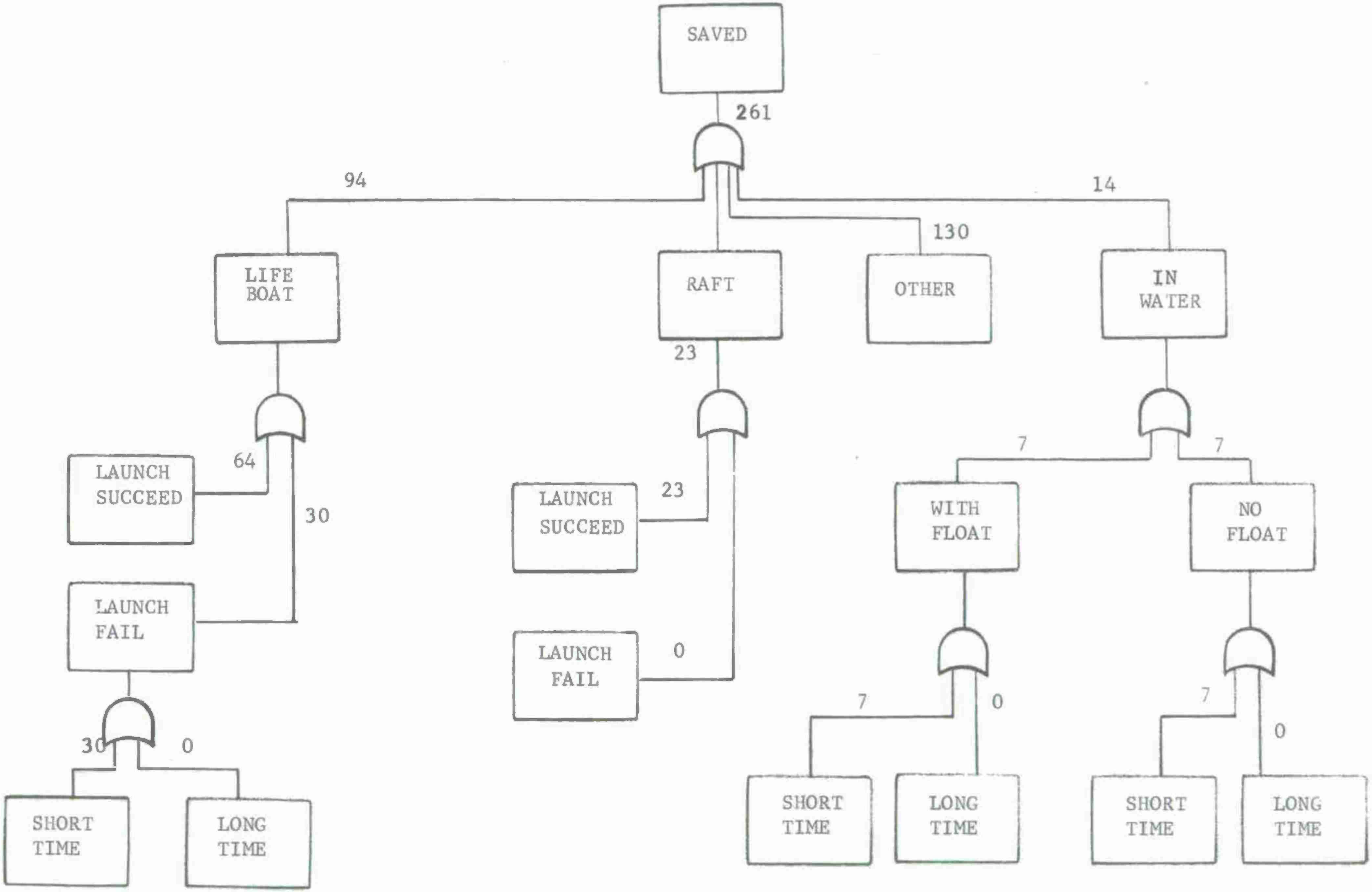


FIGURE 32. FAULT-TREE DIAGRAM
FREIGHT VESSEL ABANDONMENT (SAVED)

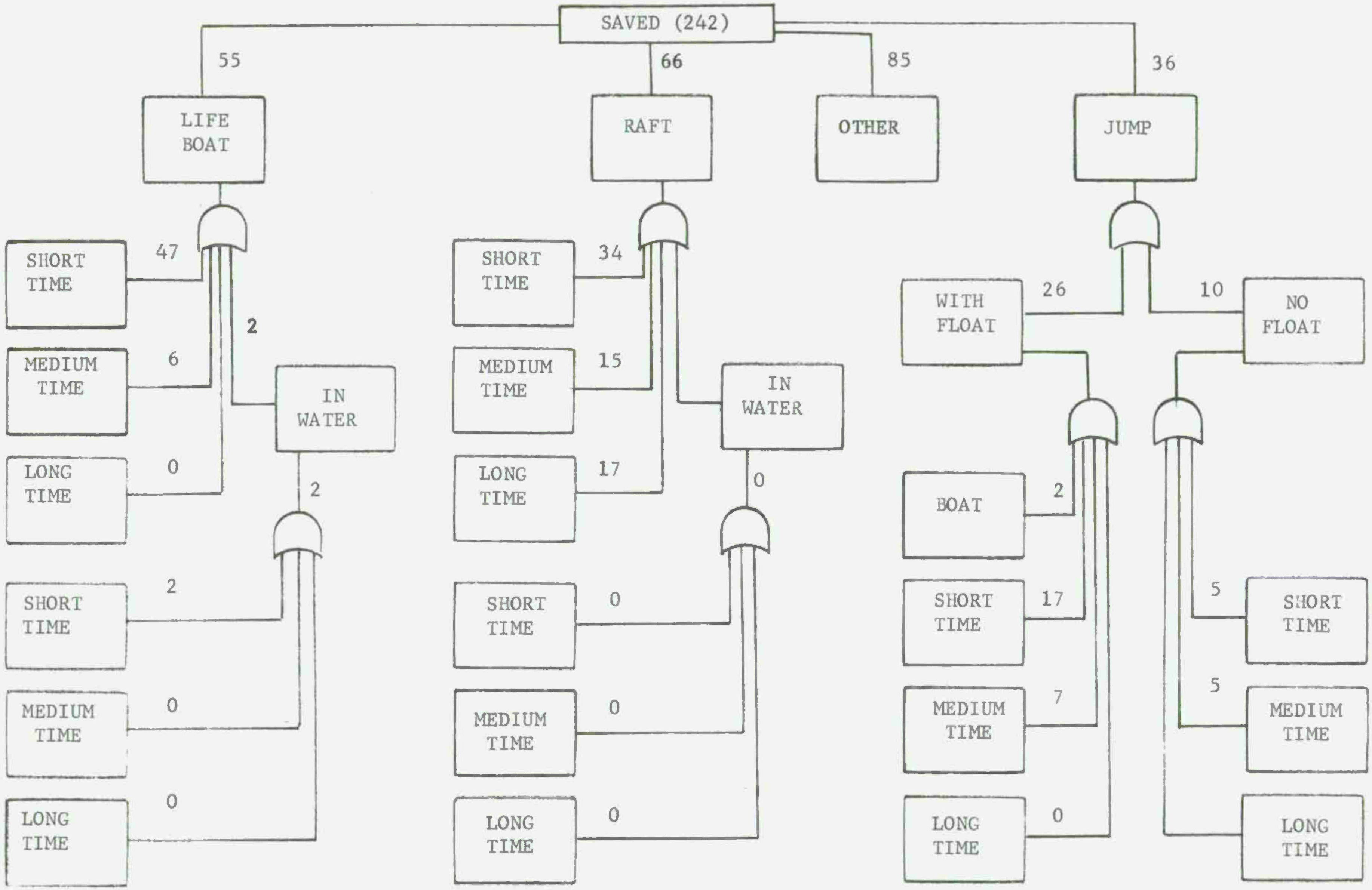


FIGURE 33. FAULT-TREE DIAGRAM
LARGE FISHING VESSEL ABANDONMENT (SAVED)

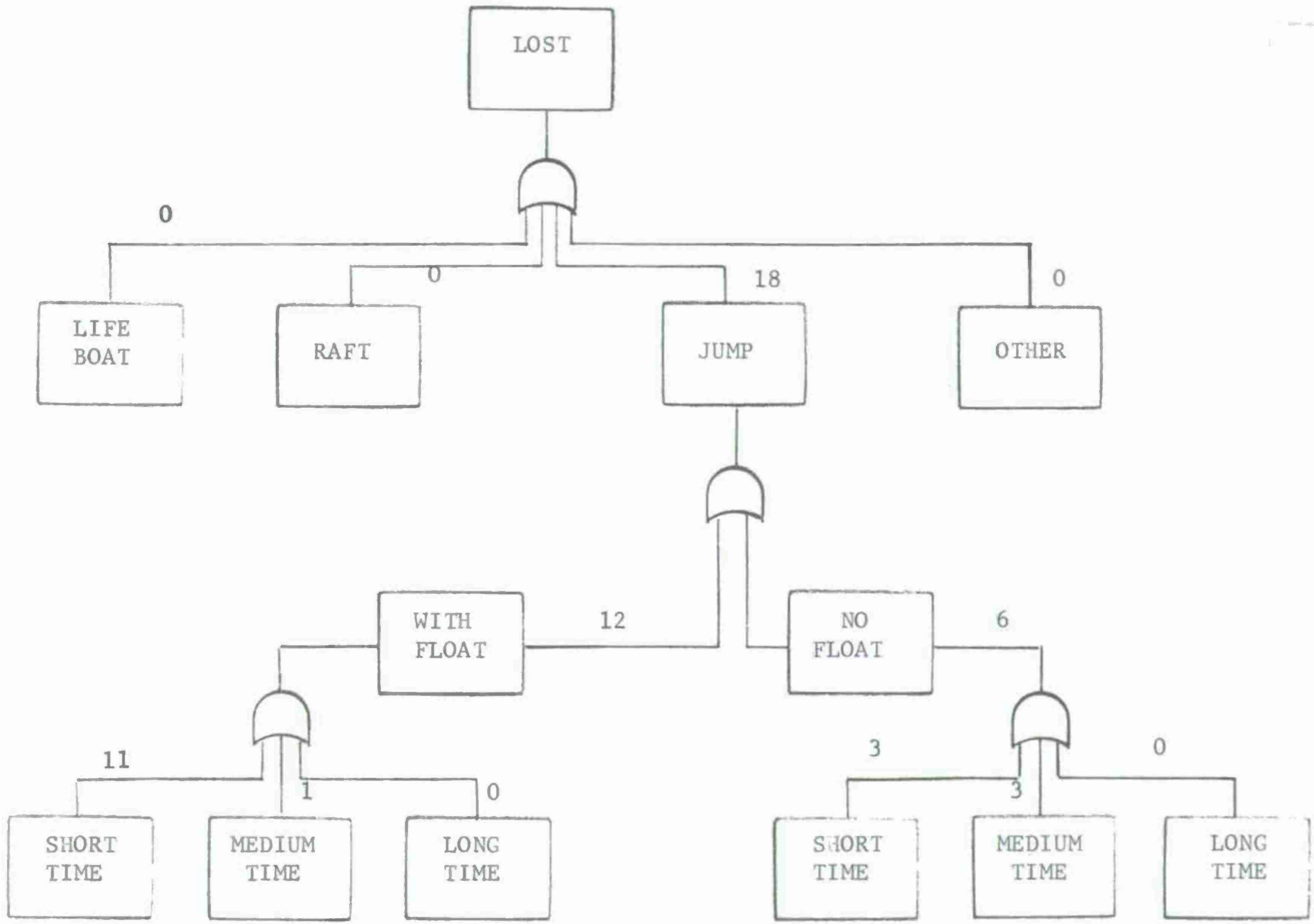


FIGURE 34. FAULT-TREE DIAGRAM
LARGE FISHING ABANDONMENT (LOST)

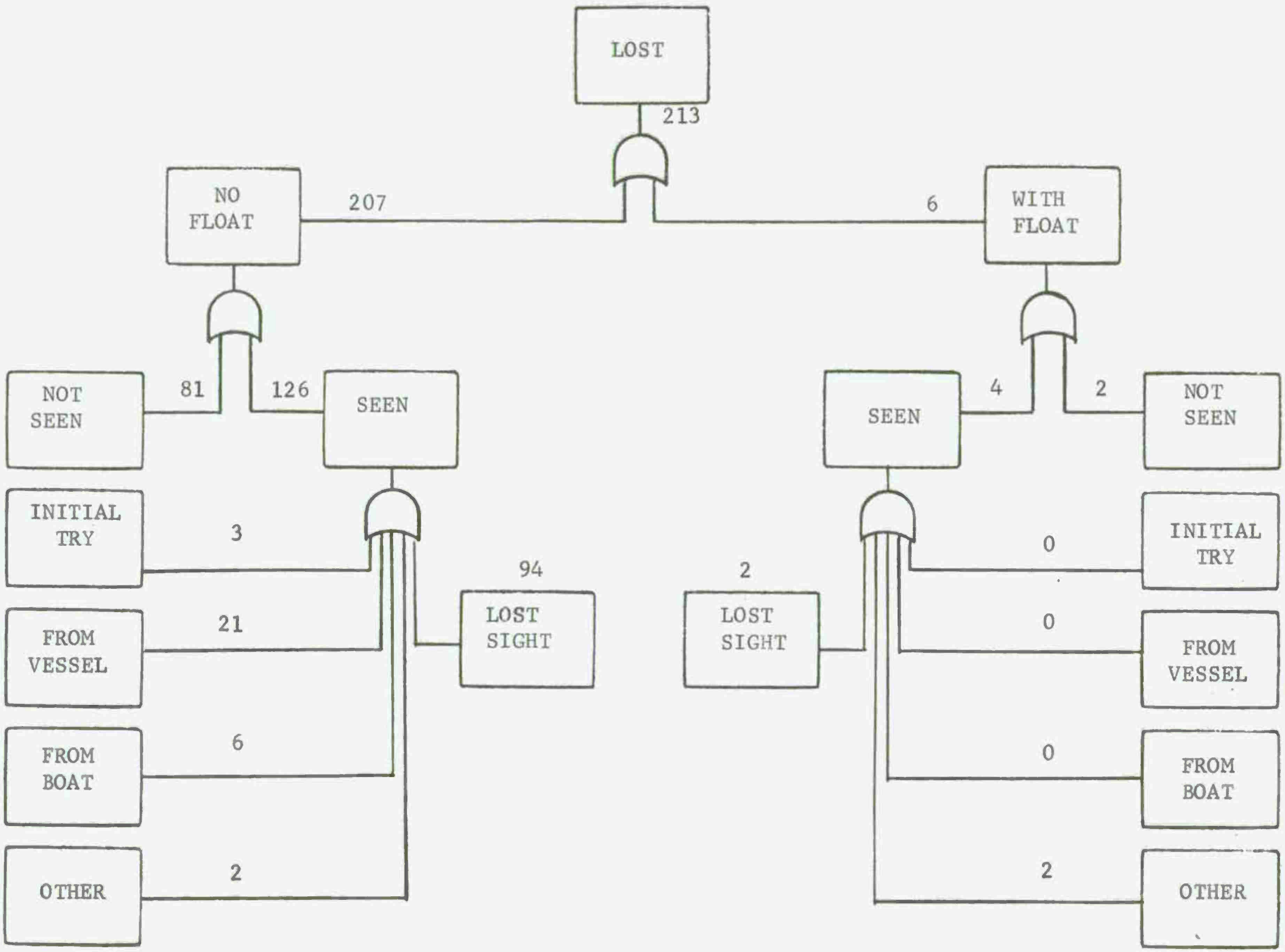


FIGURE 35. FAULT-TREE DIAGRAM
FALL FROM VESSEL INTO WATER (LOST)

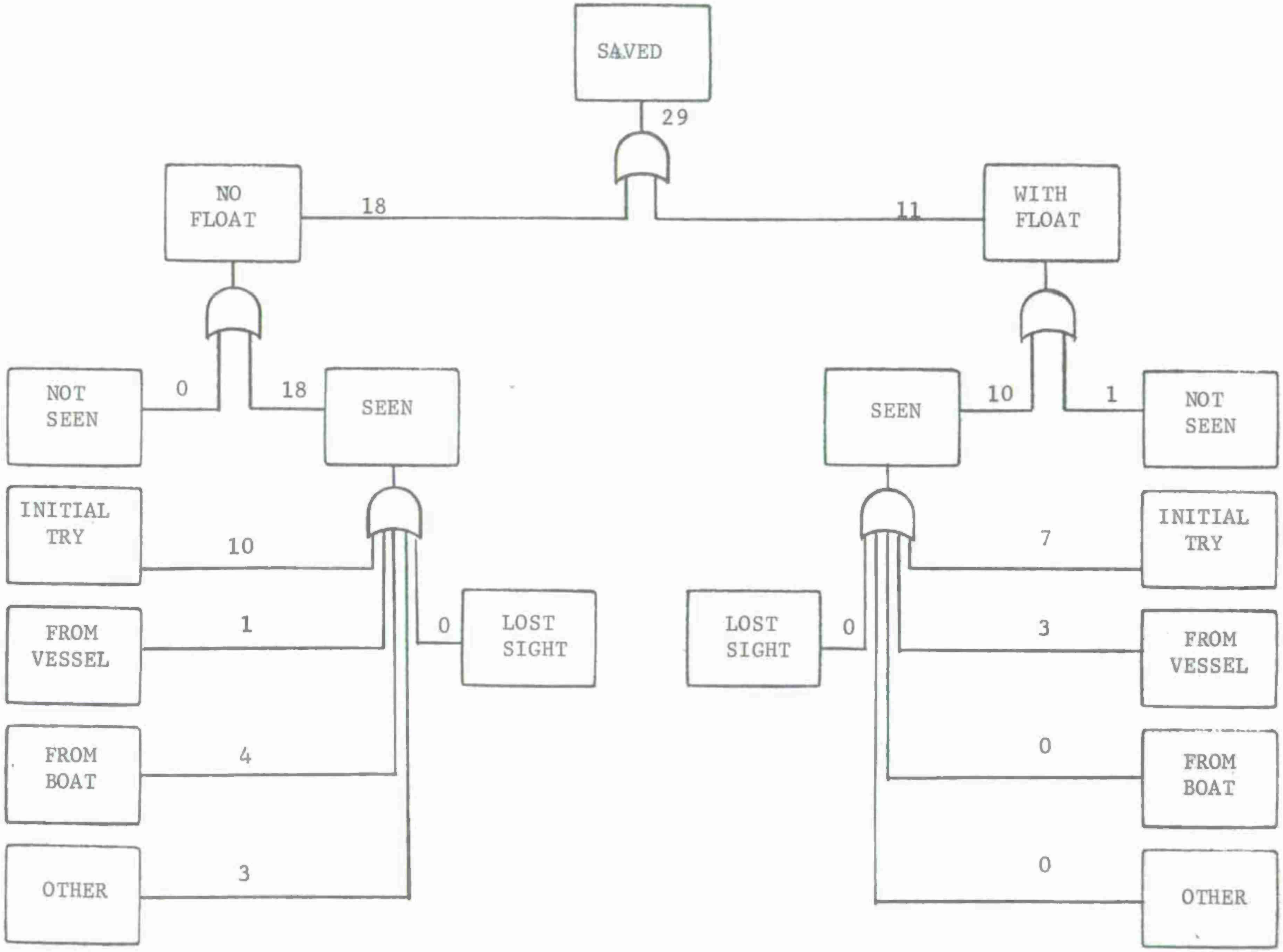


FIGURE 36. FAULT-TREE DIAGRAM
FALL FROM VESSEL INTO WATER (SAVED)

9.0 CASUALTY PROFILE SIMULATIONS

After reviewing the casualty data and considering the general types of casualties that occur and the data available for simulations, three network diagrams were developed for use in the simulations. The general cases covered by these networks are:

(1) Vessel casualties with abandonment by personnel,

(2) Vessel fires with or without vessel abandonment, and

(3) Falls from vessel into water.

These networks were then used to simulate casualty conditions for selected vessel classes using data inputs developed from analysis of casualty records.

9.1 Vessel Casualty With Abandonment (Fire Cases Excluded)

A schematic diagram is shown in Figure 37 of the simulation network for vessel casualties with subsequent vessel abandonment by personnel. For clarity in illustration, not all activity lines are shown and nodes are not identified according to type. Also, generally, programming details are not illustrated.

This casualty profile includes consideration of events for which data are available from the casualty records. The simulation starts with recognition of a casualty situation (ALARM) and terminates when personnel are either saved or lost. There are four possible modes of personnel abandonment attempts shown with consideration of subsequent events. The program for comparisons of time for vessel to sink with times used by personnel in abandonment by life boats and/or life rafts. Also, the program provides for consideration of the effects of communications and search and rescue response time with personnel survival time.

Vessel Casualty Profile Simulations

Vessel casualty simulations were accomplished for seven vessel classes using data inputs developed from casualty records. The input

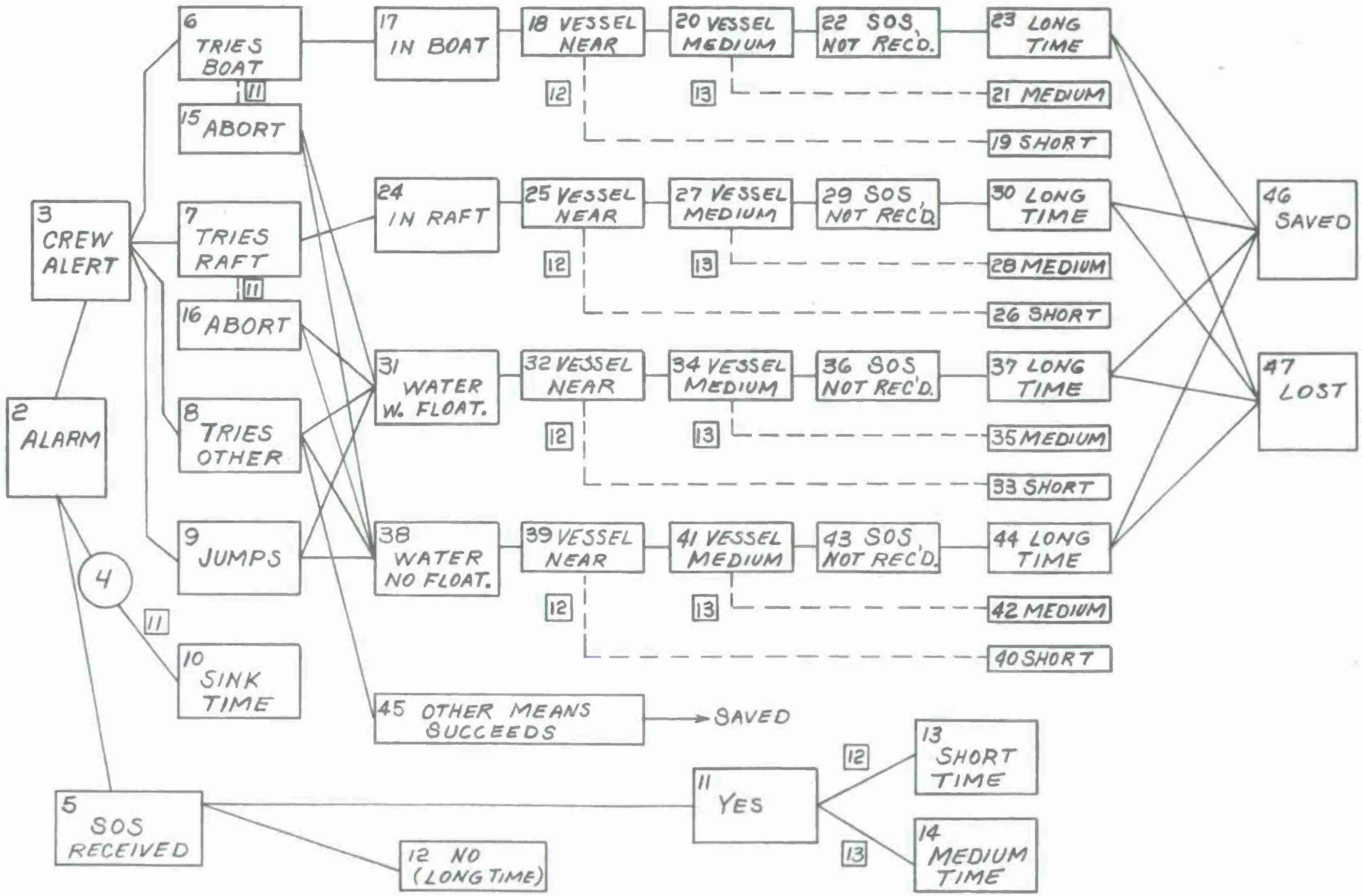


FIGURE 37. SIMULATION PROFILE FOR VESSEL CASUALTY AND ABANDONMENT BY PERSONNEL

values for these simulations are shown in Table 43. For simplicity in illustration, details required for computer programming are not shown and only the event (node) and activity data significant to the specific cases are listed. For example, activity 3/6 occurs after a crewman (person on board) recognizes that vessel abandonment is to be attempted (Node 3) and the activity from Node 3 to Node 6 consists of attempting to abandon the vessel by means of a small boat (lifeboat for large vessels; dory, skiff, or seine boat for fishing vessels). The data entry for this activity for the large fishing vessel simulation consists of a 21 percent probability of initiation and completion of this activity from Node 3, and a mean time of 0.2 hours normally distributed with a standard deviation of 0.06 hours.

For comparison the simulation input for 4/10 (vessel sink time) is a mean of 2 hours normally distributed with a standard deviation of 2 hours. Although not shown in the table, this time distribution is truncated to eliminate negative sink times and approximate a skewed distribution as observed in casualty records.

For convenience in computer operation and to provide realism in the simulations input data,adjustments were made when data from casualty analyses indicated zero and 100% probability inputs. For example, activity 3/6 for large and small passenger vessels was programmed at 0.1% probability although data records did not show any attempts to abandon ship by this method.

The simulation of abandon-ship situations associated with vessel casualties were carried out for the vessels shown. Data for large and small passenger vessels were sufficiently similar for combining in one simulation. Insufficient data were available for simulation of Tanker casualties. Data available were included in the tanker fire and abandonment simulations.

TABLE 43. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME (a)	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
3/6	Crewman attempts to abandon ship by small boat	21% 0.2,.06	0.1% 0.2,.06	37% 0.5,.15	18% 0.1,.03	05% 0.1,.03	05%	05% 0.16,0.5
3/7	Crewman attempts to abandon ship by raft	25% 0.2,.06	10.9% 0.2,.06	09% 0.5,.15	17% 0.1,.03	05% 0.1,.03	06%	12% 0.16,.05
3/8	Crewman attempts to abandon ship by transfer to another vessel or by other means	33%	79%	49%	27%	62%	62%	25%
3/9	Crewman abandons ship by jumping into water	21%	10%	05%	38%	28%	27%	58%
4/10	Sink time	100% 2,.2	100% 1,.3	100% 4.5,5	100% 0.5,.16	100% 0.5,.16	100%	100% 1, 6.
5/11	Probability of assistance being rendered by others	89%	96%	98%	94%	98%	98%	98%
5/12	Probability of assistance not being rendered by others	11%	04%	02%	06%	02%	02%	02%

(a) Time entry includes mean value and standard deviation.

TABLE 43. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
11/13	Probability of assistance being rendered by party originally in immediate area.	74%	89%	75%	84%	73%	98%	62%
11/14	Probability of assistance being rendered by party not originally in area.	26%	11%	25%	16%	27%	02%	38%
6/17	Crewman succeeds in launching small boat.	97%	80%	65%	95%	97%	95%	71%
6/31	Crewman does not succeed in launching small boat and ends up in water with floatation.	02%	15%	25%	04%	02%	04%	23%
6/38	Crewman does not succeed in launching small boat and ends up in water without floatation	01%	05%	10%	01%	01%	01%	06%
15/13	Crewman's attempt to abandon ship by small boat is aborted and crewman ends up in water with floatation.	70%	76%	71%	99%	85%	95%	60%
15/38	Crewman's attempt to abandon ship by small boat is aborted and he ends up in water without floatation	30%	24%	29%	01%	15%	05%	40%

TABLE 43. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
7/24	Crewman succeeds in launching raft.	97%	90%	65%	97%	47%	98%	89%
7/31	Crewman does not succeed in launching raft and ends up in water with floatation.	02%	07%	25%	02%	02%	01%	07%
7/38	Crewman does not succeed in launching raft and ends up in water without floatation.	01%	03%	10%	01%	01%	01%	04%
16/31	Crewman's attempt to launch raft is aborted and crewman ends up in water with floatation	70%	76%	71%	85%	85%	40%	60%
16/38	Crewman's attempt to launch raft is aborted and crewman ends up in water without floatation.	30%	24%	29%	15%	15%	60%	40%
8/31	Crewman attempts transfer to another vessel but ends up in water with floatation.	02%	07%	02%	01%	02%	02%	03%
8/38	Crewman attempts transfer to another vessel but ends up in water without floatation.	01%	03%	01%	01%	01%	01%	02%

TABLE 43. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
8/45	Crewman succeeds in transfer to another vessel or accomplishes rescue by other means	97%	90%	97%	98%	97%	97%	95%
9/17	Crewman jumps in water and ends up in small boat.	04%	02%	02%	06%	01%	01%	01%
9/24	Crewman jumps in water and ends up in raft.	02%	02%	02%	10%	01%	01%	05%
9/31	Crewman jumps in water and ends up in water with floatation.	65%	72%	47%	62%	66%	94%	56%
9/38	Crewman jumps in water and ends up in water without floatation	27%	22%	47%	17%	31%	03%	37%
9/45	Crewman jumps in water and succeeds in attempts to transfer to another vessel or rescue by other means.	02%	02%	02%	05%	01%	01%	01%
23/46	Survival probability for long-term retrieval of small boat.	85%	70%	90%	90%	40%	70%	70%

TABLE 43. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
23/47	Non-survival probability	15%	30%	10%	10%	60%	30%	30%
21/46	Survival probability for medium-term retrieval of small boat.	95%	90%	98%	98%	95%	90%	90%
21/47	Non-survival probability	05%	10%	02%	02%	05%	10%	10%
19/46	Survival probability for short-term retrieval of small boat.	99%	99%	99%	99%	98%	98%	98%
19/47	Non-survival probability	01%	01%	01%	01%	02%	02%	02%
30/46	Survival probability for long-term retrieval of raft.	80%	70%	90%	70%	40%	70%	70%
30/47	Non-survival probability	20%	30%	10%	30%	60%	30%	30%

TABLE 43. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
28/46	Survival probability for medium-term retrieval of raft.	95%	90%	98%	84%	95%	90%	90%
28/47	Non-survival probability	05%	10%	02%	16%	05%	10%	10%
26/46	Survival probability for short-term retrieval of raft.	99%	99%	99%	98%	98%	98%	98%
26/47	Non-survival probability	01%	01%	01%	02%	02%	02%	02%
37/46	Survival probability for long-term retrieval of crewman in water with floatation.	10%	05%	05%	02%	03%	65%	65%
37/47	Non-survival probability	90%	95%	95%	98%	97%	35%	35%
35/46	Survival probability for medium-term retrieval of crewman in water with floatation.	75%	47%	47%	28%	90%	88%	88%

TABLE 43. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
35/47	Non-survival probability	25%	53%	53%	72%	10%	12%	12%
33/46	Survival probability for short-term retrieval of crewman in water with floatation.	87%	89%	89%	99%	99%	97%	98%
33/47	Non-survival probability	13%	11%	11%	01%	01%	03%	02%
44/46	Survival probability for long-term retrieval of crewman in water without floatation.	05%	43%	01%	50%	01%	01%	07%
44/47	Non-survival probability	95%	57%	99%	50%	99%	99%	93%
42/46	Survival probability for medium-term retrieval of crewman in water without floatation	63%	71%	05%	61%	02%	01%	20%
42/47	Non-survival probability	37%	29%	95%	39%	98%	99%	80%

TABLE 43. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
40/46	Survival probability for short-term retrieval of crewman in water without floatation.	63%	99%	75%	73%	80%	01%	57%
40/47	Non-survival probability	37%	01%	25%	27%	20%	99%	43%

Simulation Results for Vessel Abandonment

The vessel casualty and abandonment situation (no fire) was simulated for seven vessel classes using input data derived from analysis of casualty cases. In addition, simulations were made to examine the effects of hypothetical improvements in (1) increased usage of group survival equipment, (2) increased usage of personal floatation, and (3) reduced time for rescue. The results of these simulations are shown in Table 44. The baseline case results reflect closely the data inputs derived from information listed in Tables 13 through 21, except that the simulation results are somewhat less optimistic for freight vessels and for miscellaneous vessels. With the exception of the large fishing vessels, the results of simulating hypothetical improvements show increases in the percent saved. Because the percent saved for all vessel classes was relatively high to start with, the simulation results for the hypothetical improvements are considered significant only to indicate on a general basis that the proposed hypothetical improvements would be effective. The simulation results for all cases retained in the data base the percentage of crewman abandonments by direct transfer or other means that may have been accomplished under mild weather conditions.

TABLE 44. RESULTS OF CASUALTY SIMULATIONS FOR VESSEL ABANDONMENT (NO FIRE)

Vessel Class	Percent Saved				
	Casualty Data	Baseline Simulation	Increased Usage Group Survival Equipment	Increased Usage of Floatation	Reduced Time For Rescue
Large Fishing Vessel	93	91	91	91	90
Passenger Vessels	99.6	96	97	97	98
Freight Vessels	98.1	92	92	94	94
Small Fishing Vessels	93.9	92	94	93	94
Tugs/Towboats	95.1	96	96	96	95
Platforms and Drilling Vessels	98.3	97	98	97	--
Miscellaneous Vessels	89.6	82	85	88	86

9.2 Vessel Fire With or Without Abandonment

Figure 38 is a diagram of the simulation network for vessel fires and includes events occurring prior to vessel abandonment. The simulation network starts with the recognition that a fire is started, continues with fire-fighting attempts and then simulates vessel abandonment activities. The vessel abandonment activities are similar to the events shown in Figure 37 except for the addition of a separate identification of the transfer of personnel from the vessel either directly to a rescue vessel or indirectly by means of a shuttle craft operating from the rescue vessel.

Vessel Fire Profile Simulations

Vessel fire simulations were carried out for seven vessel classes. Data from tankships and barges were combined,also data for large and small passenger vessels were combined because of similarities in events and data limitations.

Input values for the vessel fire simulations are shown in Table 45. The general methodology for listing the input data is the same as for the previous set of profile simulations on vessel abandonment. Time relationships were determined and programmed somewhat differently, however. Data available on time intervals for significant events were arranged into short, medium, and long-time intervals. Also, the simulation program was provided with a "time clock" sequence (Nodes 13, 14, 15, and 16) for apportioning the time intervals by frequency of occurrence.

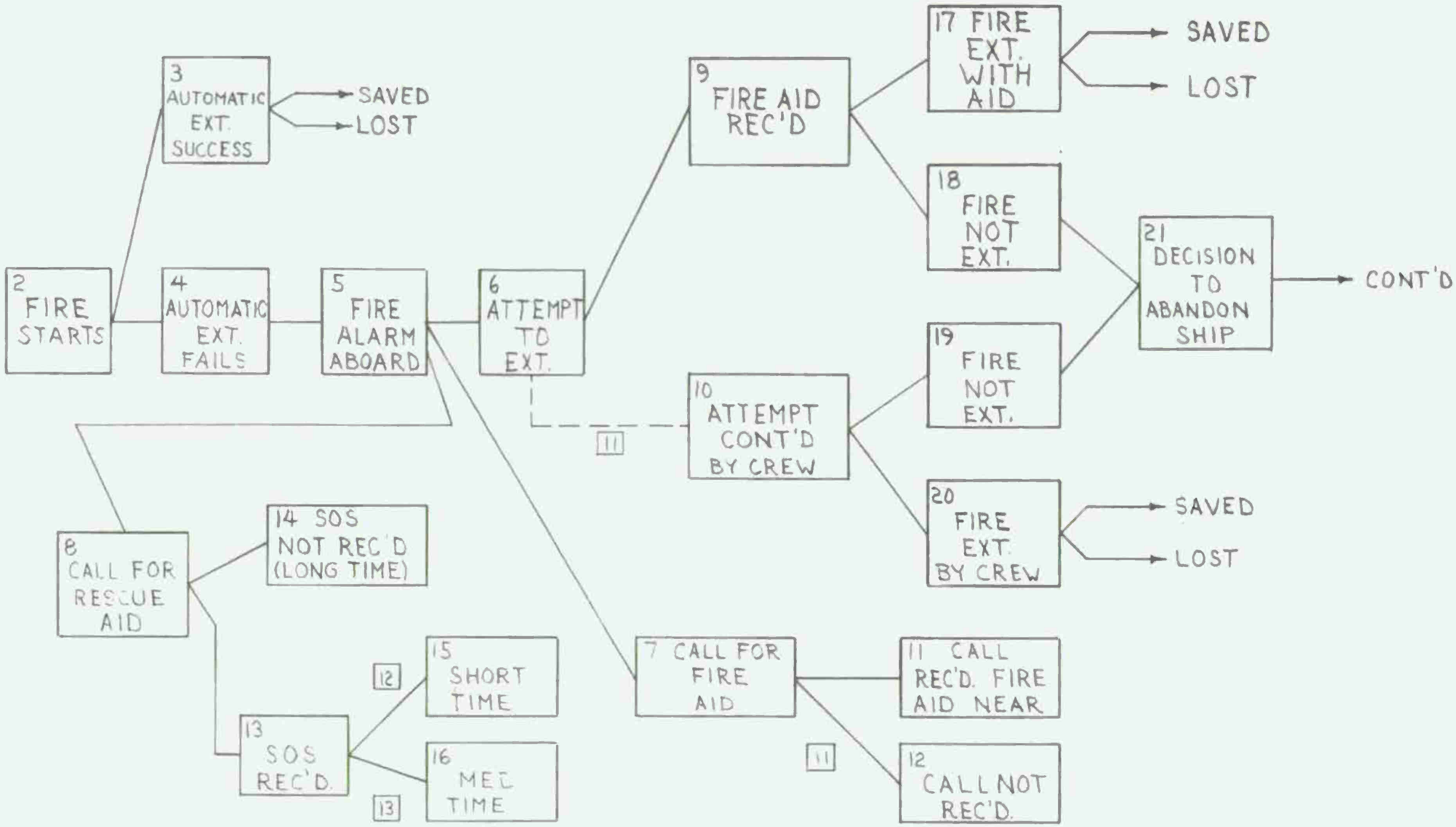


FIGURE 38. SIMULATION PROFILE FOR VESSEL FIRE

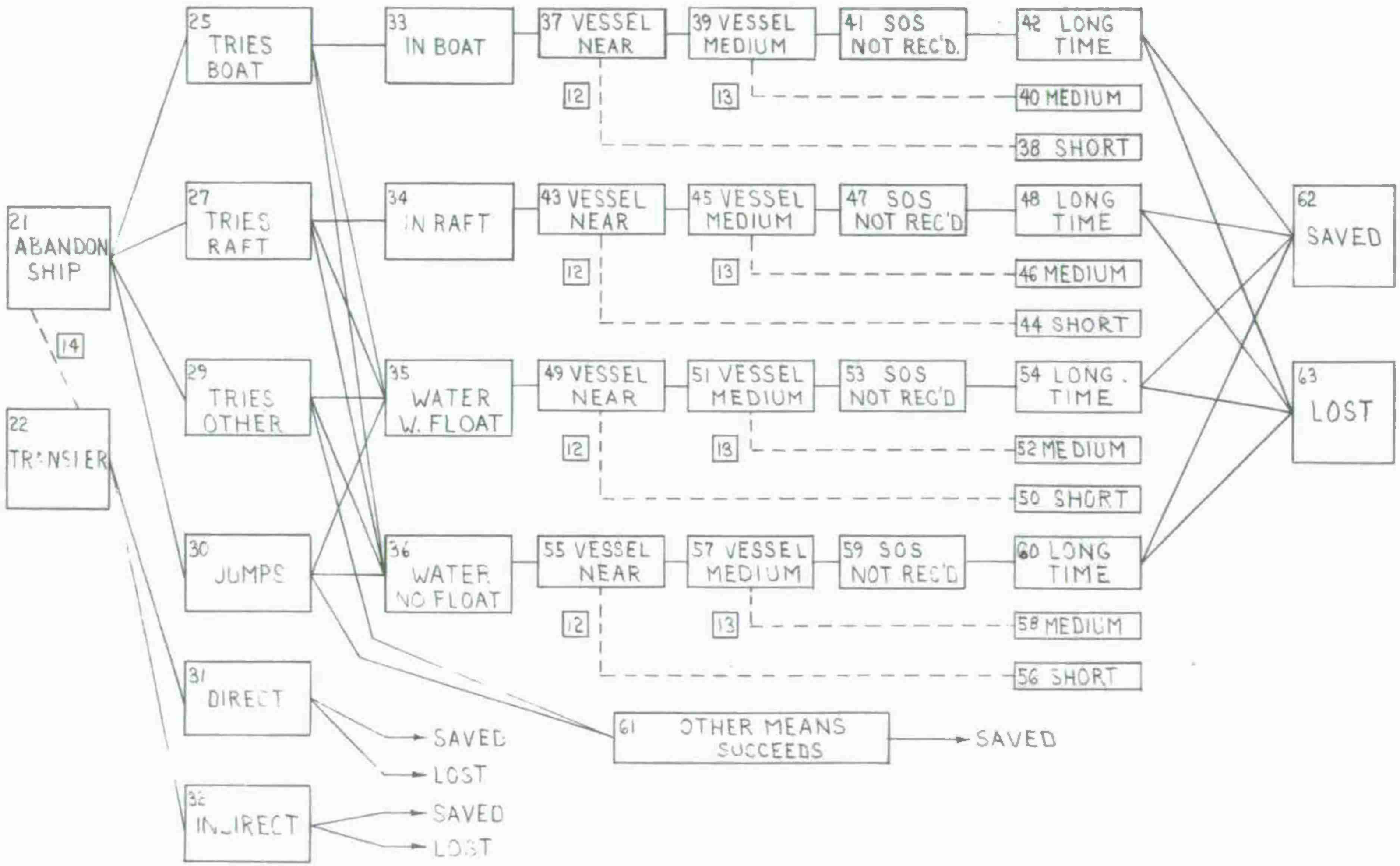


FIGURE 38. SIMULATION PROFILE FOR VESSEL FIRE
(Continued)

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT(a)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
2/3	Probability of fire being extinguished by automatic fire equipment.	01	11	01	09	01	01	01
2/4	Probability of fire not being extinguished by automatic fire equipment.	99	89	99	91	99	99	99
3/62	Survival probability of crewman if fire equipment successfully extinguishes fire	99	98	99	98	99	99	99
3/63	Non-survival probability	1	02	01	02	01	01	01
7/11	Need for fire assistance recognized by other party in immediate area	55	44	90	10	02	60	14
7/12	Need for fire assistance not recognized by other party in immediate area	45	56	10	90	98	40	86
8/13	Call for rescue assistance successfully communicated to another party	98	98	98	98	98	98	98

(a) Probability values shown are in percent.

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
8/14	Call for rescue assistance not communicated to another party	02	02	02	02	02	02	02
13/15	Party in immediate area	98	98	50	62	81	98	08
13/16	Pary not in immediate area	02	02	50	38	19	02	92
23/6	Firefighting undertaken	96	100	99	77	58	76	96
23/21	No attempt to fight fire - crewmen decides to leave ship	04	00	.01	23	42	24	04
9/17	Fire extinguished with aid of another party	03	98	99	02	22	87	95
9/18	Fire not extinguished with aid of another party	97	02	01	98	78	13	03

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
10/19	Fire not extinguished by crew without aid of another party	2	25	33	89	78	52	19
10/20	Fire extinguished by crew without aid of another party	98	75	67	11	22	48	81
17/62	Crewman survives after extinguishing fire with aid of another party	66	98	93	70	98	96	91
17/63	Crewman does not survive after distinguishing fire with aid of another party	32	02	01	20	02	04	05
17/21	Crewman decides to abandon ship after extinguishing fire with aid of another party	02	00	06	10	00	00	04
20/62	Crewman survives after extinguishing fire without aid of another party	98	98	98	57	98	98	98
20/63	Crewman does not survive after extinguishing fire without aid of another party	02	02	02	01	02	02	02

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
20/21	Crewman decides to leave ship after successfully extinguishing fire without aid of another party	00	00	00	42	00	00	00
21/25	Crewman attempts to abandon ship by small boat	32	01	01	40	29	04	05
21/27	Crewman attempts to abandon ship by raft	02	01	43	12	06	04	80
21/29	Crewman attempts to abandon ship by transfer to another vessel or by other means	28	41	43	30	03	55	10
21/30	Crewman abandons ship by jumping into water	10	30	.12	8	57	32	03
21/63	Crewman is unsuccessful in fighting fire and is lost on boat	00	00	01	10	05	05	2
22/31	Crewman attempts direct transfer to party aiding in firefighting attempt	98	98	98	98	98	98	90

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
31/62	Survival probability of direct transfer attempt	98	98	98	98	98	98	95
31/63	Non-survival probability of direct transfer attempt	02	02	02	02	02	02	05
22/32	Crewman attempts in direct transfer to party aiding in firefighting attempt or attempts rescue in another way	02	02	02	02	02	02	10
32/62	Survival probability using indirect transfer or other method of rescue	70	70	70	70	70	70	70
32/63	Non-survival probability	30	30	30	30	30	30	30
25/33	Creman succeeds in launching small boat	90	80	80	94	94	70	70
25/35	Crewman does not succeed in launching small boat and ends up in water with floatation	01	04	05	05	04	21	15

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
25/36	Crewman does not succeed in launching small boat and ends up in water without floatation	09	16	15	01	02	09	15
27/34	Crewman succeeds in launching raft	90	80	96	94	94	70	94
27/35	Crewman does not succeed in launching raft and ends up in water with floatation	01	04	01	05	04	21	02
27/36	Crewman does not succeed in launching raft and ends up in water without floatation	09	16	03	01	02	09	04
29/35	Crewman attempts transfer to another vessel but ends up in water with floatation	01	04	01	05	04	21	04
29/36	Crewman attempts transfer to another vessel but ends up in water without floatation	01	16	03	01	02	09	06
29/61	Crewman succeeds in transfer to another vessel or accomplishes rescue by other means	98	80	96	94	94	70	90

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
30/33	Crewman jumps in water and ends up in small boat	08	01	02	01	01	02	05
30/34	Crewman jumps in water and ends up in raft	01	01	02	01	01	02	05
30/35	Crewman jumps in water and ends up in water with floatation	08	19	23	96	67	65	20
30/36	Crewman jumps in water and ends up in water without floatation	82	78	69	01	30	26	20
30/61	Crewman jumps in water and is successful in transfer to another vessel or other rescue method	01	01	.04	01	01	05	50
42/62	Survival probability for long-term retrieval of small boat	60	60	60	10	10	10	60
42/63	Non-survival probability	40	40	40	90	90	90	40

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
40/62	Survival probability for medium-term retrieval of small boat	90	90	90	80	80	80	90
40/63	Non-survival probability	10	10	10	20	20	20	10
38/62	Survival probability for short-term retrieval of small boat	98	98	98	98	98	98	95
38/63	Non-survival probability	02	02	02	02	02	02	05
48/62	Survival probability for long-term retrieval of raft	60	60	60	10	10	10	50
48/63	Non-survival probability	40	40	40	90	90	90	50
46/62	Survival probability for medium-term retrieval of raft	90	90	90	80	80	80	90

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
46/63	Non-survival probability	10	10	10	20	20	20	10
44/62	Survival probability for short-term retrieval of raft	98	98	98	98	98	98	95
44/63	Non-survival probability	02	02	02	02	02	02	05
54/62	Survival probability for long-term retrieval of crewman in water with floatation	05	05	05	05	05	05	10
54/63	Non-survival probability	95	95	95	95	95	95	90
52/62	Survival probability for medium-term retrieval of crewman in water with floatation	60	85	85	75	50	20	60
52/63	Non-survival probability	40	15	15	25	50	80	40

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
FIRE WITH OR WITHOUT PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	TANKERS AND BARGES	FREIGHT VESSEL	PASSENGER VESSEL LARGE & SMALL	FISHING VESSEL LARGE	FISHING VESSEL SMALL	TUG/TOWBOAT	MISCELLANEOUS VESSEL
		PROB.	PROB.	PROB.	PROB.	PROB.	PROB.	PROB.
50/62	Survival probability for short-term retrieval of crewman in water with floatation	98	98	98	95	67	98	90
50/63	Non-survival probability	02	02	02	05	33	02	10
60/62	Survival probability for long-term retrieval of crewman in water without floatation	05	05	05	02	02	02	03
60/63	Non-survival probability	95	95	95	98	98	98	97
58/62	Survival probability for medium-term retrieval of crewman in water without floatation	20	85	.85	25	50	50	20
58/63	Non-survival probability	80	15	15	75	50	50	80
56/62	Survival probability for short-term retrieval of crewman in water without floatation	40	98	98	90	67	95	90

TABLE 45. CASUALTY PROFILE SIMULATION INPUT DATA
VESSEL CASUALTY-PERSONNEL ABANDONMENT
(Continued)

ACTIVITY NUMBER	ACTIVITY SUMMARY	FISHING VESSEL LARGE	PASSENGER VESSEL LARGE & SMALL	FREIGHT VESSEL	FISHING VESSEL SMALL	TUG/TOWBOAT	PLATFORM DRILLING VESSEL	MISCELLANEOUS VESSEL
		PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME	PROB. TIME
56/63	Non-survival probability	60	02	02	10	33	05	10

Simulation Results for Vessel Fires

The results of the network simulations for vessel fires are shown in Table 46.

As with the abandon ship simulations, these results provide a range of values from the inputs for the various vessel classes. Examination of input data shows reasons for the range of results. For freight and passenger vessels, the proportions of personnel abandoning ship were very low and none were lost in the abandonment process. Personnel who did abandon ship were mainly retrieved by direct transfer to assisting vessels or other similar methods and those in the water were retrieved in a short time by assisting vessels.

Tankers and barges, with a relatively low percent saved, lost most of their personnel on board due to the fire. This apportionment was generally the case for all vessel classes.

Simulations of hypothetical improvements were made for the tankers and barges case. It was found that with increased usage of floatation the percent saved increased to 84%. Increased usage of group survival equipment resulted in only a nominal increase indistinguishable generally from normal simulation variations. These results simply reflect that most of the losses occurred prior to abandonment.

TABLE 46. RESULTS OF CASUALTY SIMULATIONS FOR VESSEL FIRES

Vessel Class	Percent Saved	
	Casualty Data	Simulation Results
Tankers and Barges	81.2	79.4
Freight Vessels	96.4	96.7
Passenger Vessels	100.0	99.1
Large Fishing Vessels	100.0	94.9
Small Fishing Vessels	93.5	92.5
Tug/Towboats	98.5	94.9
Miscellaneous Vessels	98.8	91.9

9.3 Falls From Vessel Into Water

A diagram of the events for personnel falls from vessel into the water (man overboard) is shown in Figure 39. This diagram consists of two similar paths separated by the consideration of the usage of floatation equipment such as life preservers. Subsequent events derived from review of casualty data consisted generally of an initial try or attempt at retrieval of the man overboard followed by subsequent attempts by alternative methods. The important time element evident from the casualty accounts and simulated in the program is the time spent in the water.

Man Overboard Simulations

Data were accumulated from casualty records on man overboard events according to vessel classes; however, because the data were similar for all vessel classes, the simulations were made based on the sum total of the data. Network inputs for this baseline case are shown in Table 47.

Six types of modifications to the baseline input data were then prepared and 16 simulations were made using these inputs to consider the effect of hypothetical improvements. The network inputs for the modification are shown in Table 48. The significance of the data changes are also shown in Table 48.

Simulation Results for Falls From Vessel Into Water (Man Overboard)

The results of the computer simulations for the man overboard casualty profiles are shown in Table 49. The baseline case with a survival rate of 12 percent agrees with the analysis of data from casualty case records.

The results are tabulated for the six types of modifications considering three levels designated revision 1, 2, and 3. Revision 1, for each type of modification represents a relatively small change in

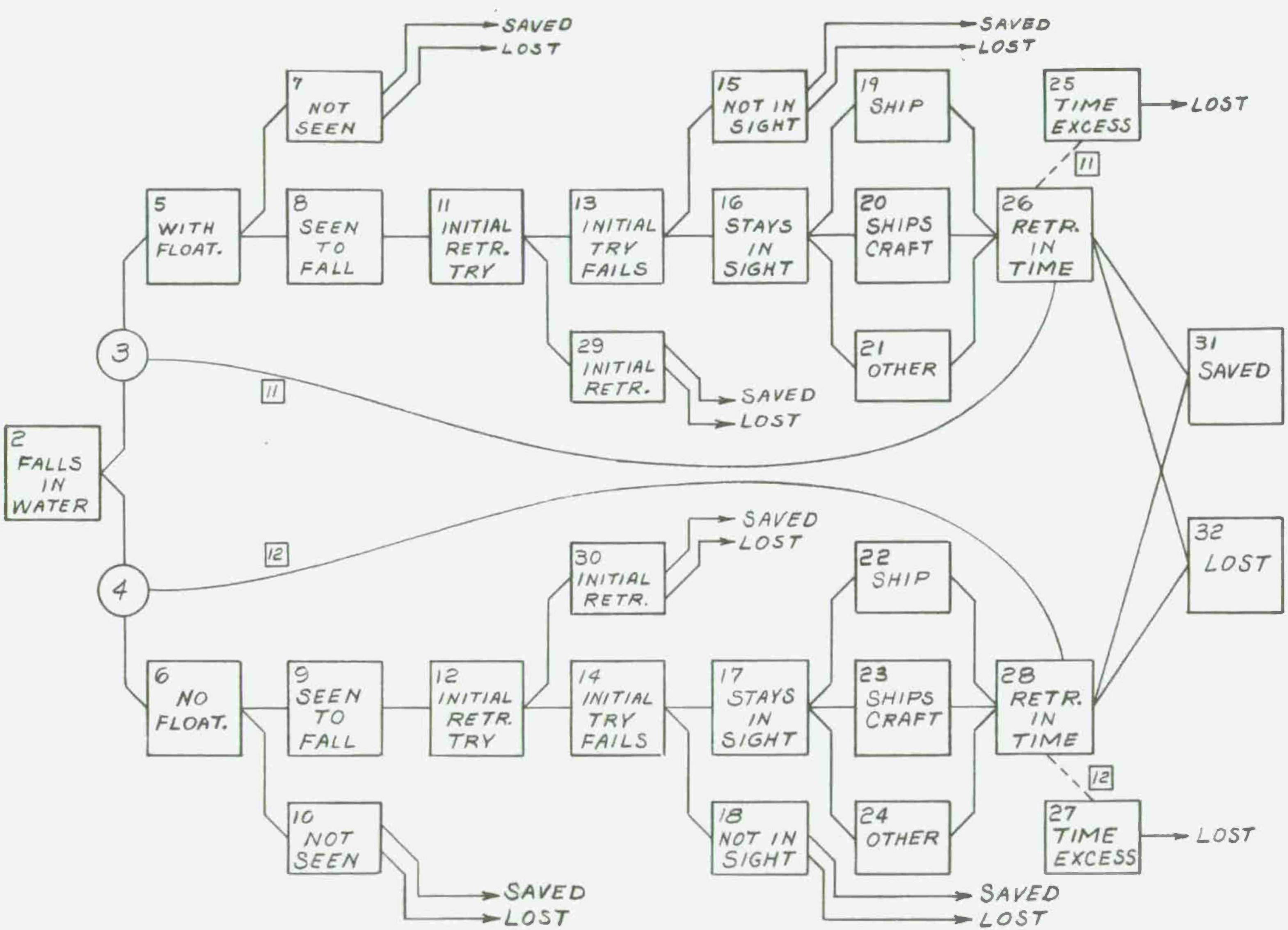


FIGURE 39. SIMULATION PROFILE FOR FALLS FROM VESSEL INTO WATER

TABLE 47. CASUALTY PROFILE SIMULATION INPUT DATA
FALLS FROM VESSEL INTO WATER (MAN OVERBOARD)

Activity Number	Activity	Probability In Percent	Time in Minutes
2/5	Crewman falls in water with floatation	9%	Nominal
2/6	Crewman falls in water without floatation	91%	Nominal
5/7	Crewman with floatation but does not receive rescue attempt	14%	Nominal
5/51	Crewman with floatation that receives rescue attempt	86%	Nominal
7/31	Survival probability of crewman with floatation but receives no rescue attempt	1%	Nominal
7/32	Non-survival probability of crewman with floatation but receives no rescue attempt	99%	Nominal
8/33	Crewman with floatation does not receive initial rescue attempt but does receive long term rescue attempt	11%	Nominal
8/3	Crewman with floatation receives initial rescue attempt	89%	Nominal
33/15	Crewman with floatation but receives no initial rescue attempt is lost from sight	1%	Nominal
33/16	Crewman with floatation but receives no initial rescue attempt remains in sight	99%	5.3 Constant
11/34	Crewman with floatation receives rescue attempt by lifelines or liferings	35%	Nominal
11/35	Crewman with floatation receives rescue attempt by other quick methods	65%	Nominal
34/13	Non-success probability of attempted rescue of crewman with floatation by lifelines of liferings	67%	5.43,1.8 Normal
34/29	Success probability of attempted rescue of crewman with floatation by lifelines or liferings	33%	5.43,1.8 Normal
35/39	Non-success probability of attempted rescue of crewman with floatation by other quick methods	53%	5.43,1.8 Normal
35/41	Success probability of attempted rescue of crewman with floatation by other quick methods	47%	5.43,1.8
3/13, 29,39, 41	Maximum drowning time of crewman in water with floatation		.1,30 Uniform
13/15	Probability of crewman with floatation that was not retrieved using lifelines or life-rings within maximum drowning time of not remaining in sight	33%	Nominal
13/16	Probability of crewman with floatations that was not retrieved using lifelines or liferings within maximum drowning time of remaining in sight	67%	Nominal

Activity Number	Activity	Probability In Percent	Time In Minutes
39/15	Probability of crewman with floatations that was not retrieved using other methods within maximum drowning time of not remaining in sight.	33%	Nominal
39/16	Probability of crewman with floatations that was not retrieved using other quick methods within maximum drowning time of remaining in sight.	67%	Nominal
29/31	Crewman with floatation is retrieved using lifelines or liferings within maximum drowning time		
47/32	Crewman with floatation is retrieved using lifelines or liferings after maximum drowning time		Nominal
41/31	Crewman with floatation is retrieved using other quick methods within maximum drowning time		Nominal
48/32	Crewman with floatation is retrieved using other quick methods after maximum drowning time		Nominal
43/32	Crewman with floatation is not retrieved using lifelines or liferings before maximum drowning time		Nominal
44/32	Crewman with floatation is not retrieved using other quick methods before maximum drowning time		Nominal
15/31	Survival probability of crewman with floatation if he does not remain in sight after initial retrieval attempt	1%	Nominal
15/32	Non-survival probability of crewman with floatation if he does not remain in sight after initial retrieval attempt	99%	Nominal
16/19	Probability of crewman with floatation receiving long term retrieval attempt from vessel	60%	Nominal
16/20	Probability of crewman with floatation receiving long term retrieval attempt by vessel's auxiliary craft	1%	Nominal
16/21	Probability of crewman with floatation receiving long term retrieval attempt by other means	39%	Nominal
19/26	Time for retrieval by vessel		11.4,3.6 Normal
20/26	Time for retrieval by vessel's auxiliarycraft		18.6,6.0 Normal
21/26	Time for retrieval by other means		132.0,42.0 Normal
51/26	Maximum exposure time for crewman in water with floatation		60.0,18.0 Normal
26/31	Survival probability of crewman with floatation rescued within maximum exposure time	99%	Nominal
26/32	Non-survival probability of crewman with floatation rescued within maximum exposure time	1%	Nominal

Activity Number	Activity	Probability In Percent	Time In Minutes
25/32	Crewman with floatation is retrieved after maximum exposure time		Nominal
6/10	Crewman without floatation but does not receive rescue attempt	39%	Nominal
6/52	Crewman without floatation that receives rescue attempt	61%	Nominal
10/31	Survival probability of crewman without floatation but receives no rescue attempt	1%	Nominal
10/32	Non-survival probability of crewman without floatation but receives no rescue attempt	99%	Nominal
9/36	Crewman without floatation does not receive initial rescue attempt but does receive long term rescue attempt	22%	Nominal
9/4	Crewman without floatation receives initial rescue attempt	78%	Nominal
36/18	Crewman without floatation but receives no initial rescue attempt is lost from sight	1%	Nominal
36/17	Crewman without floatation but receives no initial rescue attempt remains in sight	99%	5.43 Constant
12/37	Crewman without floatation receives rescue attempt by lifelines or liferings	45%	Nominal
12/38	Crewman without floatation receives rescue attempt by other quick methods	55%	Nominal
37/14	Non-success probability of attempted rescue of crewman without floatation by other quick methods	67%	5.43,1.8 Normal
37/30	Success probability of attempted rescue of crewman without floatation by lifelines or liferings	33%	5.43,1.8 Normal
38/40	Non-success probability of attempted rescue of crewman without floatation by other quick methods	67%	5.43,1.8 Normal
38/42	Success probability of attempted rescue of crewman without floatation by other quick methods	33%	5.43,1.8 Normal
4/30,14, 42,40	Maximum drowning time of crewman in water without floatation		.1-15.0 Uniform
14/18	Probability of crewman without floatation was not retrieved using lifelines or liferings within maximum drowning time of not remaining in sight	76%	Nominal
14/17	Probability of crewman with floatation that was not retrieved using lifelines or liferings within maximum drowning time of remaining in sight	24%	Nominal

Activity Number	Activity	Probability In Percent	Time In Minutes
40/18	Probability of crewman without floatation that was not retrieved using other quick methods within maximum drowning time of not remaining in sight	76%	Nominal
40/17	Probability of crewman without floatation that was not retrieved using other quick methods within maximum drowning time of remaining in sight	24%	Nominal
30/31	Crewman without floatation is retrieved using lifelines or liferings within maximum drowning time		Nominal
49/32	Crewman without floatation is retrieved using lifelines or liferings after maximum drowning time		Nominal
42/31	Crewman without floatation is retrieved using other quick methods within maximum drowning time		Nominal
50/32	Crewman without floatation is retrieved using other quick methods after maximum drowning time		Nominal
45/32	Crewman without floatation is not retrieved using other quick methods before maximum drowning time		Nominal
46/32	Crewman without floatation is not retrieved using other quick methods before maximum drowning time		Nominal
18/31	Survival probability of crewman without floatation if he does not remain in sight after initial retrieval attempt	1%	Nominal
18/32	Non-survival probability of crewman without floatation if he does not remain in sight after initial retrieval attempt	99%	Nominal
17/22	Probability of crewman without floatation receiving long term retrieval attempt from vessel	59%	Nominal
17/23	Probability of crewman without floatation receiving long term retrieval attempt by vessel's auxiliary craft	27%	Nominal
17/24	Probability of crewman without floatation receiving long term retrieval attempt by other means	14%	Nominal
22/28	Time for retrieval by vessel		11.4,3.6 Normal
23/28	Time for retrieval by vessel's auxiliary craft		18.6,6.0 Normal
24/28	Time for retrieval by other means		132.0,42.0
52/28	Maximum exposure time for crewman in water without floatation		19.8,6.0 Normal
28/31	Survival probability of crewman without floatation rescued within maximum exposure time	99%	Nominal
28/32	Non-Survival probability of crewman without floatation rescued within maximum exposure time	1%	Nominal
27/32	Crewman without floatation is retrieved after maximum exposure time		Nominal

TABLE 48. MODIFICATIONS TO CASUALTY PROFILE SIMULATION INPUT DATA-FALLS FROM VESSEL INTO WATER

SIGNIFICANCE OF MODIFICATION	ACTIVITY NUMBER	REVISION 1 PROB	REVISION 1 TIME	REVISION 2 PROB	REVISION 2 TIME	REVISION 3 PROB	REVISION 3 TIME
(1) Improved communications from man overboard to retrieval capability such as lights, reflectors, flares, sound signals, or other devices to keep the man overboard in view and located. Also assumes a resulting reduction in retrieval time.	5/7	10%		5%		1%	
	5/51	90%		95%		99%	
	6/10	30%		20%		10%	
	6/52	70%		80%		90%	
	14/17	40%		60%		80%	
	14/18	60%		40%		20%	
	40/18	60%		40%		20%	
	40/17	40%		60%		80%	
	13/15	30%		20%		10%	
	13/16	70%		80%		90%	
	39/15	30%		20%		10%	
	39/16	70%		80%		90%	
	34/13,29		5.0		4.0		3.5
	35/39,41		.01 Normal		.01 Normal		.01 Normal
	37/30,14		10.0		8.0		7.0
	38/42,40		1.67		1.33		1.17
Improved retrieval capability such as a rapidly deployed rescue craft operating from the vessel. Also assumes some improvement in initial retrieval results due to rapid response	34/13	60%		40%		20%	
	34/29	40%		60%		80%	
	35/39	50%		35%		20%	
	35/41	50%		65%		80%	
	37/30	40%		60%		80%	
	37/14	60%		40%		20%	
	38/42	40%		60%		80%	
	38/40	60%		40%		20%	
	34/13,29		5.0		4.0		3.5
	35/39,41		.01 Normal		.01 Normal		.01 Normal
	37/30,14		10.0		8.0		7.0
	38/42,40		1.67		1.33		1.17

Table 48. (cont'd)

SIGNIFICANCE OF MODIFICATION	ACTIVITY NUMBER	REVISION 1 PROB	REVISION 1 TIME	REVISION 2 PROB	REVISION 2 TIME	REVISION 3 PROB	REVISION 3 TIME
Improved alarm method to signal the event of man overboard does not assume any improvement in retrieval capability	5/51	90%		95%		99%	
	5/7	10%		5%		1%	
	6/52	70%		80%		90%	
	6/10	30%		20%		10%	
Increased use personnel floatation (Life Preservers) does not assume any improvement in retrieval capability	2/5	25%		50%		75%	
	2/6	75%		50%		25%	
Improved protection in the water. Does not assume any increase in usage rate of floatation or any improvement in retrieval capability	51/26		75		90		105
			21		36		51
			129 Normal		144 Normal		159 Normal
			18		18		18
	52/28		30		40		50
			12		22		32
			48 Normal		58 Normal		68 Normal
			6		6		6

TABLE 49. RESULTS OF CASUALTY PROFILE SIMULATIONS FOR FALLS FROM VESSEL INTO WATER

Simulation	Percent Saved			% Increase Over Baseline
	Revision 1	Revision 2	Revision 3	
Baseline Case	12%			
Improved Communications and Resulting Reduced Retrieval Time	13%	17%	19%	58%
Improved Retrieval Capability	13%	18%	24%	100%
Improved Initial Alarm Method	12%	15%	17%	42%
Increased Usage of Floatation	14%	17%	20%	67%
Improved Thermal Protection (Without Increased Use of Floatation)	15%	15%	16%	33%
Improved Communication Capability Plus Improved Retrieval Capability			30%	150%

input data, revisions 2 and 3 represent increasingly greater changes. By this methodology the apparent effects of varying levels of changes are determined.

The first type of modification represents improved communications between the man in the water and the rescue vessel. The network input changes include a reduction in the percent of persons who fall overboard without being seen, an increase in the percent of persons remaining in sight, and a reduction in the time to retrieve the person in the water. For the maximum level of input data change, the proportion of persons saved increased from 12 to 19 percent.

An improvement in retrieval capability was simulated by the second type of modification. For these simulations the retrieval time was reduced and the probability of retrieval was increased for the network inputs. This type of modification resulted in a maximum increase from 12 to 24 percent for the proportion of persons saved.

The third modification consisted of simulating improved man overboard alarm systems. The simulation was changed by reducing the percent of crewmen found missing and not seen to fall overboard. This simulation resulted in a maximum improvement from 12 to 17 percent for the proportion of persons saved.

An increased usage of personal floatation was simulated in the fourth modification. An increase from 12 to 19 percent for the proportion of persons saved was found for this modification.

The fifth modification simulated improved thermal protection for the man in the water. Network input changes were made by increasing the maximum exposure time. The simulation result increased from 12 to 16 percent for the proportion of persons saved.

The last type of modification simulated the combined effect of improved communications and improved retrieval capability. The results of this simulation were an increase from 12 to 30 percent for the proportion of persons saved.

It is concluded that although improvements in specific items of survival system equipment will result in increased proportions for the number of persons saved, the combined effect of various equipment improvements will be more effective.

10.0 RESULTS AND RECOMMENDATIONS

The results and recommendations of this study are presented according to three inter-related subject areas:

(1) General Recommendations

(2) Survival System Functional Requirements and Recommendations

(3) Summary of Recommended Improvements for Various Items of Survival System Equipment.

10.1 General Recommendations

There are five general recommendations for U. S. Coast Guard action that were drawn from this study. They are listed below on a priority basis, in accordance with our judgement on the relative potential for reducing the number of lives lost associated with commercial vessel casualties. We recommend that action be taken by the U. S. Coast Guard to:

(1) Reduce the rate of occurrance of man overboard situations

(2) Provide for improved environmental protection and more rapid retrieval for personnel who fall into the water

(3) Increase the usage of group survival equipment and/or promote equipment improvements that result in increased usage for vessel casualty cases

(4) Foster system/operational innovations to achieve increased and faster response of potential rescue capabilities for vessels in distress

(5) Promote survival system equipment improvements for various selected problem areas

Man Overboard Situations

It is recommended that action be taken to reduce the rate of occurrance of falls from vessel into water (man overboard) on a first priority basis because (1) the number of personnel lost is comparable with the number of personnel lost as a result of vessel casualties, (2) the extent of survival equipment now allocated to this objective appears to be rather minimal, (3) equipment envisioned to achieve improvements are well within our current technical state-of-the-art.

The average number of persons lost per year due to vessel casualties was calculated from U. S. Coast Guard Statistical Summaries to be 184. The average number of persons lost per year due to falls from vessel into water is 111. Of these, there were 114 deaths by drowning due to a vessel casualty and 104 deaths by drowning due to falls from a vessel into water. Also, study of the man overboard type casualty case records indicate that most of the personnel lost were not wearing life preservers or any other type of floatation equipment.

Most of the man overboard death cases are from uninspected vessels (about 31 percent from uninspected fishing vessels, 19 percent from uninspected tugs, and about 27 percent from other types of uninspected vessels such as work boats, pilot boats, barges, etc.). The reason for this may simply be that most of the commercial vessels in service are uninspected vessels.

Study of casualty case records indicates several casuative factors. For smaller vessels and fishing vessels in particular, deck duties are performed in close proximity to the water line. Personnel intoxication is a noticeable factor. An apparent lack of equipment tending to restrain personnel from falling overboard is another noticeable factor. The failure of personnel to use available safety equipment is another noticeable factor. Study of weather conditions associated with man overboard situations does not indicate that severe weather is a significant causative factor. The majority of man overboard cases occur during relatively mild weather conditions.

It is recognized that there are many actions that could be taken by the U. S. Coast Guard to reduce the rate of occurrance of man overboard situations. Considerable further study would be required to determine

those most suitable. For example, procedural type actions could include provisions for inspection of more vessel classes (specifically to include fishing vessels, tugs, work boats, and pilot boats). Also, more extensive investigations of man overboard casualties could be used to develop specific procedures that might tend to reduce the incidence of man overboard events. Other types of actions that could be taken to reduce the rate of occurrance of man overboard situations include emphasis on vessel construction and safety equipment provisions that would be effective. Examples include higher bulwarks and more effective safety rails. Some specialized types of restraint systems might be developed for use on fishing vessels for personnel engaged in net handling activities.

It is recommended that U. S. Coast Guard action be taken to provide for improved environmental protection and more rapid retrieval of personnel who fall into the water. This is a high priority item because the casualty data and simulation results show a discouraging low level of successful retrieval for personnel who fall from a vessel into the water. The successful retrieval rate is only about 12 percent or the reported loss rate is about 88 percent.

The causative and contributing factors to this low success rate include (1) failure of personnel to wear floatation (life preservers), (2) response of rescue effort slower than required for successful rescues, (3) floatation equipment inadequate for the required functions, (4) other environmental protection equipment inadequate. Study of casualty data indicates that only about 9 percent of persons who fall from a vessel into the water are wearing floatation. The average time to drown is very short, approximately 3.7 minutes, and almost all who are rescued are in the water only a short time (on the average about 5.4 minutes). Conversely, very few persons in the water a long time are rescued. Computer simulation results indicate that proportional improvements in the percentage of personnel saved can be achieved by providing both improved floatation effective on short time exposure and improved floatation plus environmental protection effective on longer time exposure.

Actions that the U. S. Coast Guard could take to increase the use of floatation and survival equipment are probably many and varied. It is recommended that some type of procedure be required such that floatation

equipment would be worn more frequently during exposure of personnel to the possibility of falling into the water. In connection with the increased usage, it is also recommended that improved equipment be developed. There are several types of improvements needed. One is the development of some type of air entrapment device that would allow a person who falls overboard to inhale sharply on first plunging into the water without drowning. The need for this is emphasized by the relative differences in survival rates for persons who jump overboard during ship abandonment and persons who fall unexpectably into the water. Another type of improvement needed is some type of provision for maintaining contact between the vessel and the person in the water. One concept for accomplishing this function is the use of a tether system. Another is the development of a high floatation, high visibility object that is perhaps tethered to the person in the water and capable of easily being contacted by rescuers on the vessel. A third type of improvement needed is an improvement in wearability of floatation equipment. It is suspected that one of the reasons for the relatively low rate of usage of existing floatation equipment is that the devices available interfere with normal activities of personnel on board ships. A fourth type of improvement would be the development of improved longer term protection for the user from severe environments. This would involve the development of devices that would provide thermal protection for persons that fall into the water, are not retrieved quickly, and do not drown quickly. The need for this type of improvement may be limited to selected environments such as the Alaskan fishing areas.

Vessel Casualty Situations

It is recommended that actions be taken by the U. S. Coast Guard to increase the usage of group survival equipment (lifeboats, life rafts, etc.) because the analysis of casualty data indicates a very high success rate for retrieval of personnel who abandon by this means. Nearly all persons who are successful in being aboard a lifeboat or a life raft are saved. (Not all persons abandoning a vessel, however, are successful in being aboard group survival equipment.)

Analysis of casualty data shows that approximately 21 percent of persons abandoning due to a vessel casualty jump into the water. The percentage is higher for selected vessel classes; about 29 percent for tugs and fishing vessels; over 50 percent for miscellaneous vessels. Most of the personnel losses from these vessel abandonment cases are from the persons who: (1) jump into the water, (2) do not succeed in attempting to use group survival equipment and fall or jump into the water, or (3) are lost on board as a result of the vessel casualty (including fire and explosion effects) or sink with the vessel. For example, for the total number of vessel abandonment cases studied, there were 3558 persons reported abandoning (plus some unreported). There were 3203 reported saved. Of these, 766 were saved from lifeboats (although only 508 succeeded in abandoning by lifeboats), 428 were saved from rafts (although only 371 succeeded in abandoning by rafts), 541 were saved from the water, and the remainder were saved by direct transfer or other means. There were 753 persons reported to have jumped into the water (for comparison with the 541 reported saved from the water).

Based on casualty case records for which completely trackable personnel data were available, of 284 persons attempting to abandon by use of life boats, 278 or approximately 98 percent were saved; of 311 persons attempting to abandon by life rafts, 308 or about 99 percent were saved; and of 504 persons who jumped into the water, 438 or about 87 percent were saved. Based on the data available there is no doubt that persons abandoning by use of group survival equipment are more likely to be saved.

It is also recommended that actions be taken by the U. S. Coast Guard to foster the development of procedural and survival equipment innovations to increase the chance of early arrival of potential rescue vessels at the scene of a casualty. The casualty data indicates that in about 32 percent of the cases, a potential rescue vessel is on scene or nearby. Study of casualty accounts indicate that radio calls for help are reported in only about 27 percent of casualty cases. Also, in many of the accounts reviewed precursors of the casualties were clearly indicated (vessel taking on water, severe weather associated difficulties, etc.). Although statistics were not compiled to illustrate the relative effect of early arrival of rescue vessels, study of the case records indicates that the need exists.

Various Equipment Improvements

There are example casualty cases that illustrate a variety of equipment improvement needs that do not reflect a high priority level relative to the total number of personnel lost but are associated with specialized applications. Examples are related for illustration.

Drilling platform casualty accounts include several cases in which personnel were required to jump or fall long distances, on the order of 50 feet, into the water. Some survived, but the need for equipment to descend safely is evident for these vessels.

Several casualty cases were found that involved the loss of pilots on boarding or departing vessels. These are included in man overboard data; however, specialized equipment is needed for this situation.

The results of studies of data on vessel fires show that most personnel losses occur prior to ship abandonment. This indicates needs for improvements in fire-fighting capabilities.

Vessel abandonment case studies indicate a very low priority for equipping lifeboats with long-term food and water supplies particularly for vessels involved in coastal shipping. Improved equipment for communications and increased application of communication equipment are indicated to supplant most of the food and water supplies.

10.2 Survival System Functional Requirements And Recommendations

Survival system functional requirements were developed according to the needs of personnel on board commercial vessels. These requirements were developed from study of casualty records, consideration of commercial vessel trends and survival-system equipment and trends, and the results of simulation analyses of selected casualty profiles. Recommendations are presented on implementation of the requirements to improve the safety of personel on board commercial vessels.

For convenience in presentation, the functional requirements are summarized in tabular form and then discussions are presented arranged according to selected vessel classes and casualty situations.

Survival System Functional Requirements for Man Overboard Situations Not Associated With a Vessel Casualty

A summary listing of survival system functional requirements for man overboard (falls from vessel into water) situations is shown in Table 50. These requirements are for situations not associated with a vessel casualty generally; however, the main distinctive element in the situation is an accidental fall from the vessel into the water.

Pre-Abandonment (Prior to Man Overboard Situation). The survival system functional requirement for minimizing the chance of falls from vessels into water requires consideration of vessel classes and environmental conditions.

It is recommended that a procedural system for alerting vessel personnsl to potentially hazardous conditions be promulgated. The environmental conditions for the safety-alert condition would be less severe for small vessels than for large vessels. For personnel on decks of tugs, fishing vessels, and other vessels less than 100-feet length or less than 100-gross tons, and with less than 4-feet high

TABLE 50. SUMMARY OF SURVIVAL SYSTEM FUNCTIONAL REQUIREMENTS FOR MAN OVERBOARD SITUATION.

Situation	Functions
Pre-abandonment functional requirements are to provide:	(1) Advance warning of potential need for use of survival-system equipment.
	(2) Accessability of equipment to user with minimum delay.
	(3) Alternative equipment capabilities compatible with vessel and environmental conditions.
	(4) Enhancement of chance of success of potential future functions (abandonment, survival, retrieval).
Abandonment functional requirements are to provide:	(1) Immediate notification of potential rescue capability.
	(2) Immediate availability of in-water capability.
	(3) Minimum physical hazard during fall into water.
Survival functional requirements are to provide:	(1) Floatation capability such that breathing capability is not disrupted.
	(2) Thermal protection compatible with water temperature and expected exposure time.
	(3) Communication for location identification.
	(4) Conservation of physical strength of survivor.
Retrieval functional requirements are to provide:	(1) Minimum time delay in accomplishing retrieval.
	(2) Compatibility of survivors equipment with retrieval capability.
	(3) Minimum demands on survivors' physical strength and dexterity.
	(4) Enhancement of self-retrieval capability.

bulwarks or life nets, the recommended alert levels are:

(1) Winds over 30 mph, or

(2) Waves over 5 ft, or

(3) Water temperature less than 45 F.

For personnel on decks of larger vessels with less than four ft high bulwarks or life nets, the recommended safety alert levels are:

(1) Winds over 40 mph, or

(2) Waves over 10 ft, or

(3) Water temperatures less than 45 F.

To implement the requirement that survival equipment be immediately available for accidental, man-overboard situations, it is recommended that personnel on decks with less than four ft protection (all vessel classes) be wearing floatation, thermal protection, and retrieval-enhancement equipment while the vessel is under way.

It is also recommended that alternative levels of equipment capabilities be available for the wearer. Floatation capability should be selected according to the deck height above the water. The thermal protection capability should be selected according to water temperature. Communication capability should be selected according to visibility and vessel operational conditions.

The enhancement of the chance of success of potential needs for use of the survival equipment can be achieved by the equipment selection and by strict adherence to the requirement for wearing the equipment. In the event of an accidental fall into the water, there is no time available for donning life-saving equipment.

Abandonment (Fall Into Water). It is required that the survival system provide immediate notification to potential rescue capabilities of the event of an accidental fall into the water. To implement this requirement, it is recommended that the notification be directed first to personnel on board the vessel using other than incidental visual means. Some type of automatic alarm equipment should be used.

As listed under pre-abandonment, the in-water survival capability is required to be immediately available to the person who accidently falls into the water. This means that it must be worn. It is recommended that the floatation capability include provisions for assuring that the wearer does not have his breathing passages submerged at any time. The floatation capability should be sufficient to prevent submergence or automatically provide an air supply during submergence. The amount of floatation (buoyancy) could be proportional to vessel freeboard. It is recommended also, that thermal protection be adjusted to minimize the cold-water shock effect to aid in assuring an uninterrupted-breathing capability and minimize the tendency toward early exhaustion.

It is required that survival equipment impose no physical hazard to the survivor during his fall from the vessel into the water. It is suggested that life nets or bulwarks at least 4 ft high be installed along deck edges where structural protrusions occur that present physical hazards during falls into the water. Obviously such protection is desirable on all ship classes and around all deck edges. It is recognized, however, that cargo handling and other operational needs may make complete deck-edge protection unfeasible.

Survival (In-Water). A floatation capability adequate to assure uninterrupted breathing is required for the person in the water. This capability requirement is proportional in part to sea conditions. Breathing passages must be supplied with air when seas are rough and confused as well as when seas are smooth.

Thermal protection is required for the person in the water adequate for the water temperature and the time of exposure. It is recommended, for example, that an effective clothing insulation value of at least 1 clo be provided for water temperatures down to 45 F. More is desired.

Communication capabilities for location identification are required so that retrieval may be accomplished. There are many alternatives for achieving this requirement. For example, a life line attached between the person in the water and the retrieval capability,

two-way radio communications, lights and reflectors to enhance visual communications, etc. For fishing vessels and tugs where deck activities are performed in close proximity to the sea level, it is recommended that some type of life line be used. The life line could be extensible to minimizing interference with deck duties and attachable at selected locations adjacent to work areas. In addition to performing the communication function the life line could also be used for retrieval. The attachment of the life line to the person in the water should not interfere with floatation. Such a life-line arrangement might also be used to activate an alarm system.

It is required that the physical strength of the person in the water be sustained for his survival. The implementation of this requirement may be achieved in combination with other requirements. Adequate floatation capability and thermal protection will strongly aid in conserving the survivors' strength. Automatic equipment for communicating the survivors' location to rescue capabilities will also aid in strength conservation. It is suggested that survival equipment for the person in the water not be dependent on any physical effort from the survivor.

Retrieval. A minimum time delay in achieving retrieval of persons in the water is a requirement for successful retrieval. It is recommended that retrieval be accomplished in 30 minutes or less. For small vessels such as fishing vessels, tugs, pilot boats, and small work boats, the vessels may be expected to maneuver within the time requirement so that retrieval can be accomplished from the vessel. For larger vessels, freighters, tankers, and passenger vessels with longer maneuvering time requirements, it is recommended that a rescue capability be developed with a short-time response. A powered life boat might be suitable; however, a more promising approach would be a ramp-launched small craft that is seaworthy and can be brought rapidly to sea level.

It is required that functional compatibility be achieved between the survivor in the water and rescue retrieval capabilities to achieve successful retrieval. Hand-to-hand compatibility is

commonly encountered in casualty reports. It is recommended that survival equipment be provided with features to enhance compatability. Floating lines attached to lifting points on floatation/survival suits are one example. Rescue craft should be pre-equipped with life lines, floatation suits for rescue personnel, and boarding ramps that lower into the water.

The requirements for minimum demands on the survivors' physical strength and dexterity may be achieved by adequacy of equipment associated with retrieval activities. For smaller vessels accomplishing retrieval directly from the vessel, life lines attached to the survivor may be used to lift the survivor from the water. It is recommended that consideration be given to the development of a net-type retrieval device that could be used to envelop and lift the survivor from the water. As indicated above, small rescue craft should be pre-equipped with retrieval capabilities.

The requirement for enhancement of self-retrieval capabilities is particularly appropriate for barges and vessel operations on rivers and coastal waterways. This enhancement can be implemented by floatation improvements and thermal protection improvements for the survivor in the water.

Survival System Functional Requirements For Situations Involving Vessel Casualties

Survival system functional requirements for situations involving vessel casualties are presented in this section. The requirements were developed considering the needs of personnel on board ship subjected to the necessity of ship abandonment. A summary of the functional requirements is shown in Table 51 arranged according to events. A discussion section follows with implementation recommendations according to vessel classes.

Pre-Abandonment. To minimize the chance of personnel loss due to a vessel casualty it is required that some type of personnel preparation and training be carried out. Life-boat drills and fire drills are two methods now used.

It is recommended that a procedural system be promulgated to alert personnel to conditions that may be precursors of vessel casualties. The conditions recommended are less severe for small vessels than for large vessels. Also, for consistency in practice, the conditions are similar to the conditions recommended for the man-overboard situation. For tugs, fishing vessels, small passenger vessels, and other small vessels of less than 100-ft length, or less than 100 gross tons, the recommended alert levels are:

(1) Winds over 30 mph, and

(2) Waves over 5 ft, or

(3) Water temperature less than 45 F, or

(4) Dense fog.

For freight vessels, tankers, large passenger vessels, and other vessels of 100-ft length, 100 gross tons, or more, the recommended alert levels are:

(1) Winds over 40 mph, and

(2) Waves over 10 ft, or

(3) Water temperature less than 45 F, or

(4) Dense fog.

TABLE 51. SUMMARY OF SURVIVAL SYSTEM FUNCTIONAL REQUIREMENTS FOR VESSEL CASUALTY SITUATIONS

SITUATIONS	FUNCTIONS
Pre-abandonment functional requirements are to provide:	(1) Advance warning of potential need for use of survival-system equipment. (2) Advance notification of potential need and confirmation as soon as possible of need for retrieval/rescue assitance. (3) Availability of alternative modes of abandonment and survival-system equipment in a stand-by status.
Abnandonment functional requirements are to provide:	(1) Communication to all vessel personnel of the decision to abandon ship. (2) Communication to potential retrieval/rescue capabilities of the status of personnel (vessel abandoned, location, etc.) (3) Immediate accessability of survival-system equipment for use by personnel. (4) Protection for personnel from environmental forces - wind, waves, cold temperatures. (5) Safe and expedient transport of personnel and survival equipment to the water.
Survival functional requirements are to provide:	(1) Personnel protection from the environment - thermal protection, physical protection, floatation. (2) Maneuverability capability for interim "rescue" of personnel in the water. (3) Communications to potential retrieval/rescue capabilites of the status and location of survivors.
Retrieval functional requirements are to provide:	(1) Continued physical protection of personnel during retrieval operation. (2) Compatibility of survival-system equipment with retrieval equipment. (3) Minimum demands on survivors' physical strengths for accomplishment of retrieval operation. (4) Enhancement of self-retrieval capabilities.

In addition, for all vessels, any known vessel structural inadequacy that might develop into a loss of water-tight integrity should also be cause for a personnel-alert situation.

During the alert, personnel on decks with less than four-foot high bulwarks or life nets should be wearing personal-floatation equipment. Personnel on protected decks or below decks should have personal-floatation equipment readily available, and access passages to group-survival equipment should be checked.

It is recommended also, that a communication-alert system be implemented on a relatively short-time-interval basis, say every two hours. For vessels traveling in proximity with other vessels a "buddy system" could be used. For isolated vessels, communication contact could be maintained with shore-base stations. The need for such communications is illustrated by casualty cases resulting in vessel losses not discovered apparently until several days later.

The communication-alert system would provide an advance notification of the potential need for retrieval or rescue assistance.

It is also required that more than one mode of vessel abandonment and survival-system equipment be available to personnel prior to a ship-abandonment situation.

Abandonment. It is required that the survival system function to notify all vessel personnel of the decision to abandon ship. To implement this requirement, it is recommended that the alarm system be operable independently of the ship's electric system and propulsion system.

It is also required that communication of the event of ship abandonment be made to potential retrieval/rescue capabilities. Other vessels in the vicinity of the stricken vessel should be notified and public rescue capabilities such as the U.S. Coast Guard should be notified. The notification should include information on vessel location and status. As soon as possible, the status of survivors should be communicated. To implement this requirement it is recommended that two radio systems be maintained - one powered independently of the vessel's main electrical system. For vessels operating on intercoastal

waterways, rivers, and coastal regions, the range of the communication equipment may be substantially less than for ocean going vessels.

It is required that survival-system equipment be available to all personnel aboard ship. To implement this requirement, at least two modes of abandonment should be provided. One mode may be the conventional life-boat system. However, casualty records show that a high percentage of personnel abandon ship by other means such as by jumping into the water. Thus, an alternative mode of vessel abandonment should be provided. It is recommended that some type of equipment be developed such that personnel on board may safely abandon ship without depending on the group-survival equipment. This requires personal protection from the adverse environment (wind, waves, cold water) plus some method of transport of personnel to the water. Except for offshore platforms and large vessels, the freeboard distance from main-deck level to the water is not expected to prevent abandonment; however, to prevent submersion, to minimize the chance of injury due to collision with hull surfaces, and to protect the survivor from currents and wave forces at the waterline, some alternative abandonment mode is needed.

During abandonment and subsequently during the survival phase, personnel protection from environment is required. Life preservers, now in common use, appear inadequate. Protection is needed from wave splash and also, thermal protection is needed to minimize the shock of cold-water immersion.

Survival. During the survival phase it is required that personnel be protected from the adverse environment - floatation, physical protection, and thermal protection are necessary.

For personnel in group-survival craft (life boats and rafts) most of this protection can be integral with the survival craft. For personnel in the water, however, as indicated above, floatation, wave-splash protection, and thermal protection is needed.

For potential long-term survival (more than two hours) it is also required that a means of maneuverability be available on group-

survival equipment to gather individual survivors out of the water into group-survival equipment. To achieve this requirement, it is recommended that all ocean-going vessels be equipped with a powered rescue craft capable of being launched and maneuvered in very adverse environments. It is not necessary that the craft be capable of high-speed operation. It is necessary that provisions are made for in-water retrieval of personnel and the craft should be equipped with at least one small inflatable life raft or similar device to aid in retrievals.

It is required that communication capabilities be provided all survivors. At least one long-range, two-way radio should be available to survivors of ocean-going vessel casualties. For coastal waterways, a two-way radio should also be available; however, the range could be less (on the order of 100 miles). For river traffic, the communication's requirement could be satisfied by use of on-board equipment prior to abandonment and then by passive and less complex communicators for survivors in the water and/or in group-life-saving equipment. To implement these needs it is recommended that survival systems on ocean-going vessels be provided with one long-range radio in one of the main group survival items of equipment (life boat or life raft) and one long-range radio in the rescue boat. For vessels engaged in coastal waters, at least one, and preferably two of the group-survival items of equipment (depending on vessel size) be equipped with short-range (commensurate with distances to shore-based stations) radios. All personnel-survival equipment should be equipped with passive communication equipment such as light reflectors and at least some form of active communication equipment such as whistles, underwater clackers, and battery-powered lights. The devices should be effective both day and night under adverse environmental conditions.

It is recommended that adequate floatation, environmental protection, and communications capabilities be provided so that retrieval can be accomplished in a relatively short time even for mid-ocean situations. Thus, the long-term survival rations, food, water, etc., would be no longer needed.

Retrieval Phase. The functional requirements during retrieval activities include continued physical protection of survivors and compatability of retrieval equipment with survivor equipment. To achieve this, the survival equipment should be provided with attachment points to aid in retrieval. For example, personal-floatation devices should have lifting rings or short lanyards with loops or rings. An improved personnel-transfer system should be devised and implemented such that survivors are not required to climb rope ladders, nets, and similar items that demand physical strength and dexterity.

Another requirement is the enhancement of self-retrieval capability. This requirement applies to vessel activities in coastal areas near shore and river traffic. This requirement can be achieved by improvements in capabilities of floatation equipment (no immersion and wave-splash protection) and improved thermal protection for survivors.

10.3 Summary of Recommended Improvements for Various Items of Survival System Equipment

For summary purposes, a brief listing is presented of the various survival equipment improvements that are recommended. More details on these recommendations were presented in previous sections.

1. Equipment improvements intended to reduce the chance of occurrance of man overboard casualty situations
   - Higher bulwarks and more complete deck edge protection on all vessel classes
   - Improved safety rails including mesh or gridwork construction to prevent personnel losses through railings
   - Pnysical restraint mechanisms to accomodate personnel working in areas where deck edge protection is removed.
2. Improved environmental protection for personnel in the water
   - Personal floatation equipment improvements to prevent drowning on initial entry into the water
   - Personal floatation equipment improvements to reduce splashing hazards
   - Thermal protection commensurate with the risk of cold water exposure
   - Improved wearability for personal floatation equipment
   - Communication equipment developments that are economically feasible and effective for personnel in the water.
3. Improved equipment for vessel abandonment situations
   - Descent mechanisms for use on vessels with high freeboards

- Improved communication devices operable independently of vessels electrical power system for both crew notification and potential rescue vessel notification
- Provision of multi-modal means of vessel abandonment available for use by all vessel personnel
- Improvements in communication equipment to assure pre-abandonment notification for personnel on board and for potential rescue vessels
- Consideration of the capability of abandonment equipment to perform adequately under expected environmental conditions.

4. Improved capability of group survival equipment
   - Improved equipment to enhance communications between survivors and potential rescuers
   - Maneuverability for gathering in-water survivors
   - Reduced emphasis on very long term survival.
5. Improvements in retrieval equipment
   - Rapid response equipment for man overboard situations
   - Equipment suitable for automatic notification of vessel personnel that a man overboard situation has occurred
   - Improvements in personal floatation equipment to enhance retrieval functions
   - Improvements in retrieval equipment to minimize the physical effort required of survivors on boarding rescue vessels.

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APPENDIX A

CASUALTY SUMMARIES

APPENDIX A

A1.0 CASUALTY SUMMARIES

This Appendix presents summaries of selected casualty cases from the files of the U.S. Coast Guard Headquarters, Washington, D.C. These summaries are assembled into five sections: Abandon Ship (no fire), Abandon Ship (fire), Vessel Fire, Man Overboard, and Casualty Board Review Cases. The first four are narrative summaries of casualties that involved hazards to personnel, and the fifth is a tabular presentation of information relative to major vessel casualties.

A1.1 Abandon Ship (No fire)

Passenger (100 gross tons or over)

10002 H/S SUN ARROW, passenger, diesel, 135 gross tons, 93 net, 100 ft, inspection certification dated December 29, 1969, from San Juan, Puerto Rico, Master licensed by C.G., Italian vessel.

March 20, 1970, 17:40, Caribbean sea, shallow water south of Culebrita Island.

Weather - clear, visibility 10 mi, wind ESE, 10-15 kts, 81 F, sea 3-4 ft, ENE, swell 4-6 ft, ENE.

At 17:40 the master of the hydrofoil Sun Arrow mistook a red buoy for a black buoy and grounded on the reefs approximately 1 mile S of Culebrita Island. There were 6 crew and 117 passengers aboard. The vessel was extensively damaged. The U.S.C.G., Navy vessels and helicopters assisted.

At approximately 17:50, the vessel seemed to speed up to become foil borne, and a few seconds later it ground to a sudden halt on the reefs and rocked back and forth in the swells. There were no announcements made over the public address system, and although the Master appeared a few times he never issued any orders. He tried for a few minutes to back the vessel off the reef; however, all his efforts were in vain. The hydrofoil was firmly wedged on the reefs with one section

of the afterfoil broken and penetrating the hull. The passengers remained calm while the crew scurried around checking appendages and internals. Life jackets were passed out by passengers top side to those in the upper and lower cabins. The life rafts were checked for releasing while two or three of the male passengers passed the word that there was no immediate danger and that the help was on the way. The officers of the Sun Arrow never at any time notified the passengers of the extent of the situation, action taken to obtain assistance, or condition of the vessel.

The Coast Guard Rescue Coordination Center at San Juan received the first message concerning the casualty at 17:55, and at 18:04 a helicopter was launched. At 18:25 a fixed-wing aircraft reported on the scene and stated there was no indication of immediate distress and that all passengers were wearing life jackets. Attempts to communicate with the stricken vessel were fruitless, and a decision was made to lower an officer from the helicopter to the foredeck of the Sun Arrow to coordinate rescue operations.

Passengers in the aft lower compartment of the vessel discovered that water was seeping in from the manhole covers in the deck. The chief engineer had opened the manholes in St. Thomas to check piping and the vessel departed before they could be secured. Two passengers and a deck hand worked on these covers trying to stem the flow of water. The C.G. indoctrinated a male passenger in the procedure to be used in assisting survivors in the helo-basket pick-up method, and then requested a life raft be provided from one of the C.G. choppers.

The passengers and crew had difficulty in releasing Sun Arrow rafts because they were lashed as well as secured with painted cable and pelican hooks. Two or three of the rafts were inflated. Due to the fact that they were the enclosed-canopy type, it was felt they were unsafe to use. The C.G. Mark 20 life raft was used extensively during the rescue.

The motor vessel, Carib Star, was standing by in deep water approximately 500-yards south of the casualty scene. The yacht, O'Neady, being of shallower draft, was much closer. The first raft was filled

with survivors, and the C.G. officer jumped in with the passengers and one hydrofoil crewman to maneuver the raft which drifted to the O'Neady. During the unloading process, the raft was ruptured and began to sink. However, the passengers on the raft made it safely to the O'Neady.

During this interim, helicopters were ferrying survivors from the Sun Arrow to the Isle of Culebrita and another Mark 20 raft was dropped alongside. The O'Neady maneuvered close to the Sun Arrow and transferred the C.G. officer and crewman to the hydrofoil via the second raft. The O'Neady rendezvoused with the Carib Start to transfer the 16 survivors. However, due to sea conditions, transfer was hazardous and they moored instead at Culebrita to wait for air lift to Roosevelt Road.

Wind became brisker, darkness fell, and rain squalls belted the area. At 19:30, the C.G. cutter Point Whitehorn arrived on the scene and attempted a bow-to-bow evacuation; however, due to the sea condition and the reef hazards, this attempt was abandoned in favor of the vessel-to-vessel raft shuttle transfer method.

During the evacuation, the raft floor became holed; most likely survivors had not removed their shoes before they jumped to the raft--approximately 6 ft. One girl survivor jumped completely through the raft, but quick action on the part of two other survivors prevented an otherwise serious casualty. At approximately 21:00, a passenger jumped to the raft and fractured her right ankle. By 21:15 all survivors had been successfully rescued from the vessel and the C.G. officer was retrieved by helicopter. The Captain, chief engineer, and three deck hands elected to remain aboard the vessel pending salvage operations. Marine and C.G. helicopters ferried survivors to Roosevelt Road. The Point Whitehorn rendezvoused with the Carib Star docked in Culebrita to off load two passengers for helicopter evacuation to Roosevelt Road.

At 6:14, C.G. cutter Sagebrush sent a rescue and assistance party aboard to dewater the Sun Arrow. Salvage operations continued through March 22, when she was successfully refloated and towed to San Juan for survey. On March 26 the Sun Arrow was loaded aboard a cargo vessel and shipped home to Masina, Italy.

The cause of the casualty was a navagational error. Officers of the Sun Arrow did not discharge their duties properly in an emergency situation. They did not speak fluent English. There were sufficient life rafts available, although not altogether suitable for rescue operations. It is concluded that if the Sun Arrow rafts had been secured with Hydrostatic releases, it would have been less of a problem to cut them free. The quick action and level headedness of a few male passengers averted a panic situation and contributed to the success of the rescue operation, and all 117 passengers were successfully evacuated by boat and helicopter. Approximately 15 minutes prior to the casualty, a passenger asked a crewman why the vessel was cruising on the hull instead of the foils. The reply was that they were going through some straits. Another passenger noticed that spray was striking the windshield. The windshield wipers were not working continuously, and the pilot appeared to be searching for something.

The comment about the unsuitableness of the rafts provided pertain only to this method of evacuating from one vessel to another. Closed-canopy rafts probably are better suited to abandoning vessels in the open sea where some degree of protection is required.

Passenger (less than 100 gross tons)

12322 DAISY MAE, fishing charter boat, diesel, 25.44 gross, 43 ft wood, 1963, uninspected. Master licensed by C.G.

May 15, 1971, 05:15, Gulf of Mexico International 72 miles from Clearwater sea buoy, Florida.

Weather - partly cloudy, visibility 1 mile, wind NE, 15-18 kts, gusty, temperature 65 F, sea choppy, 75 F 2-3 ft N, swell 6 ft N.

One of the crewmen awoke to find the back deck awash and called to the rest of the men. They then checked the stern but could find nothing and later decided that the only possible reason for sinking was that one of the exhaust hoses must have broken. The seven crewmen aboard then sent out a "mayday" and about 15 seconds later, after putting on life preservers, went into the water hanging onto an unidentified buoyant apparatus. Although the "mayday" was sent out the first message received by the Coast Guard was at 11:50 EDT, when the MV Double Eagle II reported picking up survivors from the Daisy Mae. Reportedly the buoyant apparatus was C.G. approved. The life preservers worn by the seven crewmen also were C.G. approved. The vessel sank in 180 feet of water and was a total loss.

12013 LOOKOUT, passenger and fishing, diesel, 17 gross, 37.3 ft, wood, 1956, uninspected, Master licensed by C.G.

December 21, 1970, 16:15 EST, Gulf of Mexico, South of Buoy 26 in NW channel at Key West, Florida, Inland Rules.

Weather - clear, visibility 5 miles, wind E 10 kts, air temperature 75, sea calm, 1-1/2 ft W, swell 2 ft but only from passing boats.

The Lookout and the F/V Tridon were approaching one another on a heading situation when the starboard engine of the Lookout stopped. The Lookout then crossed the bow of the Tridon and the Tridon struck the Lookout, and knocked the transome off the Lookout. The Lookout then sank. The one crewman and five passengers abandoned the ship with life jackets and were picked up by the Tridon. There were no injuries in this casualty. All six persons aboard the Lookout were in the water and were picked out of the water by the Tridon. The Lookout sank almost immediately.

10007 BLUE STAR, passenger and freight, diesel, 35 gross tons, 64.5 ft, steel, 1955, certificate of inspection April 15, 1968, Master licensed by C.G.

July 1, 1970, 19:25 PDT, Le Conte Bay, Petersburg, Alaska.

Weather - overcast, visibility 15 miles, no wind, 48 F, no sea.

The vessel struck a knife-like projection radiating out from a floating iceberg. The ice pierced the vessel's starboard catamaran hull, in way of the outboard bow. As water flooded into the starboard hull, the crew took the vessel to the shore and grounded it to prevent capsizing. Additional pumps were received from the Coast Guard and a commercial helicopter service. With the flooding controlled, the vessel proceeded out of Le Conte Bay, transferred its passengers to the Coast Guard Cutter Henlopen and proceeded to Petersburg, Alaska, with the Cutter in company. Passengers were transferred directly from the vessel to the Cutter. The vessel had 10 passengers and 3 crew members aboard at the time of the casualty. There were no injuries and no one went into the water although the passengers had donned life preservers.

10051 J.W.M. II, private yacht, diesel, 17 gross tons, 37 ft, fiber glass, 1957, uninspected, Master licensed by C.G.

July 5, 1970, 09:55, Gulf of Mexico, Block 3, West Delta area.

Weather - overcase, visibility 5 miles, winds SW 8-18 kts, gusty, 87 F, sea moderate, WSW, swell 3-5 ft WSW.

The vessel left dock on July 5 at 07:00 on a fishing trip with five passengers on board. The radio and equipment checked out in perfect order. Upon reaching Rig 73, the vessel was tied to one corner and the engine shut down. The operator proceeded to the cabin to obtain fishing rods. Upon coming onto the after deck he sensed that the vessel didn't seem to be riding right. He lifted the hatch in the aft compartment and found it half full of water. He then went to the flying bridge to put in a "mayday" call to Grand Isle Coast Guard Station. However, he did not get an answer. After two more calls, he looked at the aft hatch and found it three-quarters full of water. He then broke out the life jackets and proceeded to get them on the persons aboard. In the meantime, he gave a distress signal to the vessel Pat Owl,

which was tied to the other corner of the rig and he proceeded to the assistance of the vessel which was sinking. By the time the operator got off the flying bridge, the aft deck was awash so he issued orders to abandon ship. He made sure that all persons had left the vessel before he abandoned the craft. From the time he noted that the vessel had taken on water to the time that the vessel was completely submerged was no more than 10 minutes. Two of the persons didn't have time to put their life jackets on properly so the operator assisted them while in the water. The vessel, Pat Owl, picked up four of the survivors. A work boat from the rig came to the assistance of the vessel and picked up the remaining survivors. There were 5 passengers and 2 crew members aboard the vessel. All 7 were picked up without injury and all 7 wore life preservers. The J.W.M. II sank completely. Apparently the radio signal, which was transmitted, was not received; however, some type of signal, probably visual, to the other vessel in the area was answered.

10280 CAVU, charter yacht, sloop, rigged sail, equipped with 16 hp diesel engine, 40 ft long, 11.5 ft beam, 5 ft draft.

June 30, 1970, 23:00 EDT, Straits of Florida, 11 miles E of West Palm Beach, Florida.

Weather - partly cloudy, visibility 15 miles, wind 60 F at 15 kts, air temperature unknown, sea slight, 3 ft NE, swells 3 ft NE, sea temperature unknown.

On June 30, 1970, at approximately 23:00 EDT, the destroyer escort Blakely and the yacht Cavu collided in the Atlantic Ocean. As a result of the casualty, two persons from the yacht suffered injuries incapacitating them for more than 72 hours. Four other persons from the yacht suffered minor injuries. The Cavu was sunk, the Blakely sustained minor injuries. The yacht was chartered from Soverel Marine, Incorporated. A foreman with that organization was assigned as the qualified mate and as operator for the yacht. At approximately 21:00 EDT, June 20, 1970, an unidentified vessel was sighted. Another vessel, later identified as the Blakely, was also sighted approximately 6 miles away; both vessels were traveling in a northerly direction. No further attention was paid to

the Blakely. When the foreman was assured that the first vessel would safely pass ahead of the Cavu, he altered the course of the yacht to 115° magnetic, its original heading. At that time, the Blakely was estimated to be approximately 1000 yards away and closing rapidly. He attempted to cross ahead of the Blakely at approximately 23:00 EDT, and at approximately 11 miles east of West Palm Beach the yacht Cavu was struck on the starboard side amidships by the Blakely. At the time of the casualty, the foreman was operating the wheel, and the party chartering the boat was handling the sails and all other persons were on deck. Passengers were thrown clear of the Cavu but the foreman was trapped inside. However, after several attempts he was able to escape from the yacht. Six persons remained in the water using wreckage and a ring life buoy with a water light attached until rescued by the small boat off the Blakely.

Immediately after collision, the officer on watch aboard the Blakely rang all stop on the engine telegraph, and told the helmsman to come hard left, that he would reverse course to pick up survivors. The Blakely lowered her 26-foot motor whale boat and picked up the 6 survivors of the Cavu. According to the foreman, the life-saving equipment on the Cavu consisted of two ring buoys with water lights attached, two 4-man inflatable life rafts, and 6-8 approved life preservers in their original plastic containers. The other persons on the yacht were unaware of the presence of the life preservers or life rafts. At approximately 23:13 EDT, Miami Coast Guard Rescue Coordination Center was advised of the casualty. At approximately 23:19 a C.G. helicopter was airborne. At 23:20 a C.G. patrol craft was under way. C.G. helicopter landed on the Blakely at 00:10 EDT, July 1, and transferred all survivors to West Palm Beach. At the time of the casualty the Cavu was under both engine and sail.

11703 BLUE SEA II, passenger (charter fishing), 48 gross, 65 ft, wood, 1963, certificate of inspection December 7, 1970, Master licensed by C.G.

January 30, 1971, 22:45, Lakeworth Inlet, Florida

Weather - overcast, visibility of light about 65 mi, unlighted objects 25 ft, wind SE 15-25 kts, gusty, air and sea temperature unknown, sea choppy 4-6 ft SE. No swell.

There were three crew and 25 passengers aboard for a normal night's fishing. They started home about 22:15. One crew member in the wheelhouse, one crew member in the stern. Coming in the boat was in the channel for a moment, and then back out and the boat hit. The engines were not slowed down until the boat stopped. The Captain tried to back off the boat but the other crew members said that he shouldn't try to do it. The crew members broke out the life jackets and passed them out. The C.G. came in and attempted to get the people off the boat, but were unable to do so because of sea conditions. The people were then lowered to the rocks and were helped across. The master had called the C.G. while the crew members were passing out life jackets to the passengers. The crew members rigged a line over the starboard side of the bow. One crew member got on the rocks below and the other crew member and the Captain helped the people over the rail and down to the rocks, and with the help of the police and a couple of people ashore the crew got everyone over the few rocks between the boat and the flat cement part of the jetty on which they had grounded. The life jackets were then returned to the boat and the people were able to get rides back to the dock. The cause of the casualty was pilot error. There were no injuries resulting from the grounding and although life jackets were used none of the passengers or crew went into the water.

22129 C/B RED ROOSTER, charter, uninspected, diesel, 31 ft lg, 1961, unknown tons.

May 27, 1972, 07:10 hrs, between end of South Jetty and Buoy #2 Umpqua River, Bar, Mouth of Umpqua River, Oregon, Pacific Ocean.

Weather - fog, 75 yard visibility, Wind SE, 5 kts, 45 F, water rough, 2-3 ft waves, S, 8 ft swell, W.

While exiting the harbor the boat was struck by two successively large waves causing vessel to capsize and sink. Only one person had a life preserver--Coast Guard vessel nearby saved all 8 persons on board.

20717 M/B SNOOK, passenger, diesel, 21 gross tons, 14 net, 43.7 ft x 13.7 ft, wood, 1956, draft 2 ft forward and aft. Inspected May 31, 1970, Master licensed.

Octover 29, 1971, 18:10 EDT, Chesapeake Bay.

Weather - fog, visivility 1.4 mile, wind N 10-15 kts, gusty, 70 F, sea choppy, 2-2-1/2 ft N, swell 2-1/2 ft S.

While under way at 16:30, starboard engine stopped. When operator checked in engine compartment and found 3 ft of water, he called the USCG for assistance at 16:35 after starting bilge pumps. At 16:45 radio and bilge pump ceased when water reached batteries. Vessel Linwood Holton sighted Snook at 17:55. When it was apparent the Snook could not be saved, operator (only person aboard) boarded 11-person life float and departed at 18:00. Snook disappeared under water, stern first, at 10:10. Linwood Holton took operator aboard at 18:15. Cause of casualty is unknown--material failure in vessel's hull or hull fitting--total loss.

21369 GOLDEN ARROW, passenger, diesel, 35 gross tons, 15 net, 48 ft x 9.5 ft (breadth x 12.8 ft (depth)), wood, 1931, draft 4.5 forward and aft. Inspected, Master licensed.

April 18, 1971, 05:30 CST, Gulf of Mexico (Inland rules), Baratoria Pass Approach, Louisiana.

Weather - partly cloudy, visibility 8 miles, wind SE 15-20 mph, upper 60's, sea choppy - 50's, 4-7 ft SE, swells 5-8 ft SE.

At approximately 04:30, the Golden Arrow departed Grand Isle, Louisiana, with a crew of 4 and 10 passengers. When vessel reached area of Lighted Buoy #8, a sharp crack-like noise was heard and water immediately entered the forward head, galley flooring, forward berthing compartment, and engine area. Speed was reduced and all persons donned life preservers. The bilge pump unable to keep up. The vessel was turned to port in an attempt to reach Lighted Buoy #8 to moor and prevent sinking. A broadside wave broached vessel and it began to sink. Ship was abandoned within 5-10 minutes

of broaching. The 11-man life raft was launched and all 14 persons abandoned vessel. Three orange day-type flares were used on two occasions (6 flares). M/V Oriole responded to flares and all persons were aboard within 20-30 minutes of Golden Arrow's sinking (persons were in water 10-20 minutes before pickup). There were no radio calls for help; all power was lost when vessel broached. There were no injuries. The Golden Arrow broke up by wave action and was a total loss.

11556 M/V DOWRELIO NO. 5. Party fishing boat, diesel, 12 gross tons, 38 ft, wood, 1943, inspected, draft 2-1/2 ft forward, 3-1/2 ft aft. Master licensed.

September 5, 1970, 08:45 , Carquiniz Strait, (San Pablo Bay, California).

Weather - clear, visibility unlimited, wind NW, 4 kts, sea calm.

While under way with crew of 1 and party of 12, Dowrelio No. 5 started to take on water. Called Harbor Master for assistance (previous call to Coast Guard before it was known that vessel was sinking). Cabin cruiser Jackqueline came alongside and passengers stepped from one boat to the other. After futile attempts to pump out and to tow, Master also stepped aboard Jacqueline. Dowrelio No. 5 sank. Operator did not have the 12 passengers don life preservers when he found that his vessel was sinking. The conclusion was that all persons aboard vessel escaped death because of immediate availability and assistance of other vessel.

Freight vessels

10083 P-TEE, passenger and coasting trades, diesel, 61 gross tons, 72 ft, wood, 1942, inspected, Master licensed.

May 27, 1970, 22:30, Atlantic Ocean, one-half mile from harbor of Refuge Light Station.

Weather - clear, visibility 10 miles, wind 300° at 10 kts, gusty, air temperature 60 F, heavy surf, water temp. 50 F, sea 3-4 ft from 300°, swell 3-4 ft.

The P-Tee was towing the dredge Nanticoke. The dredge tender work boat broke loose and rammed into the stern of the P-Tee and punctured a hole in the hull causing the engine room to flood, the boat went down by the stern. The vessel was a complete loss and completely sunk by daylight. The three crewmen aboard had life jackets. They were taken off the vessel by a 33 footer out of the C.G. station. There were no injuries in the casualty.

The dredge was left unattended but anchored. Some time during the night it capsized and sank and eventually washed in on shore up-side down. Apparently, the work boat from the dredge was a 24 footer. This was being towed by the P-Tee and holed it. Probably the crew then got onto the work boat. The Cape May Coast Guard station responded and stood by. The Indian River Coast Guard gave the operator a tow line, then returned to their station. Then the 33 footer out of the Lewis Coast Guard station apparently took the work boat into tow. The work boat had broken loose and turned over and the crew were then taken off by the 33 footer.

11991 NORA W., freight diesel, 76 gross tons, 74.5 ft, wood, 1941, inspected, Master licensed.

February 17, 1971, 19:00, Chesapeake Bay.

Weather - sea calm. No other data on sea or weather conditions.

While proceeding outside the marked channel, the vessel struck a submerged object which tore a hole 3 ft long and 3 inches wide in the bottom of the boat. The engine room flooded and the vessel was above water. The two persons aboard were removed by another boat. No life-saving equipment was used. There is no information on the length of time it took to be removed from the boat. The C.G. was notified but apparently some time after the casualty. There were no injuries in this casualty.

10246 KOYO MARU, coastal cargo vessel, 2,739.32 gross tons, 1,723 net tons, 289 ft long, 47 ft wide. Single acting 4 stroke, 6 cylinder, 470 x 820 mm propulsion, 2500 hp, steel hull, 1968.

July 22, 1970, 20:22 hours, Pacific Ocean International. Mike Moto Chima in the waters of Sagami Nata, Japan.

Weather - winds SSE, 2 kts, seas smooth, visibility 2-5 miles, light haze, highlight fog with scattered stars visible. Mike Moto Light visible for 9 miles.

At 20:05 hours, the Captain of the Hapan Bear went to the bridge because the vessel was approaching Mike Moto Chima for a course change. The third mate manned the radar scope because the second mate and Master were on the bridge. While the Captain was on the bridge, the crossing situation which resulted in the collision developed. The Captain noted an unknown vessel crossing from starboard and ordered right rudder when this unknown vessel was approximately 3 points to starboard--3 miles distant. A port to port passing was successfully completed. When cleared of the first unknown vessel, he ordered admidships only momentarily, 5-10 seconds, when he noted the Koyo Maru 3 points to starboard. The Captain ordered hard right, sounded one short blast, and continued in the starboard turning radius. No signals were heard from the Koyo Maru. At approximately two ship lengths from the point of impact, the Japan Bear ordered engines back full and held for approximately 1 minute until collision. No danger signals were sounded from either vessel. After impact, the Japan Bear stopped engines. The Captain was then primarily concerned with rendering assistance to the Koyo Maru which remained afloat. Within minutes, the Master of the Koyo Maru and 18 crew members were aboard their raft. The Koyo Maru was abandoned with generators running and lights burning brightly. There were no injuries or loss of life sustained by either vessel. At 21:10 hours, the survivors of the Koyo Maru were picked up by the Japan Bear.

22402 PIONEER, freighter, 11,164 gross tons, 531 st, steam, 1963, inspected.
MARU, coastal freighter, 696.2 gross tons, 220 ft, diesel, 1970.

April 27, 1972, 06:46 hours, Middle Section, Tokyo Bay.

Weather - overcast, foggy, 15-mile visibility, no wind, calm sea.

While under way, Pioneer rammed Maru causing extensive damage and immediate sinking. Life rings were thrown overboard and a life boat lowered. Two of the seven persons on board the Maru were rescued from the water by life boat--the remaining five picked up by a motorboat in the vicinity and all were transferred to the Pioneer. Little damage was done to the Pioneer.

32919 CAROL ANN, freight vessel, 83 ft long, 97 gross tons, 1873, radio.

May 16, 1973, NE coast of Puerto Rico, 08:30 hours.

Weather - partly cloudy, visibility 4 miles, winds easterly at 12-20 kts, gusty, with air temperature 80 F, sea conditions were rough with 3-5-1/2 ft sea and a 3-7 ft swell.

There were four persons aboard. The vessel was turned, about to return to San Juan, P.R., when the engine room was flooded and the engine stopped. The turn around was a 08:00 and the ship sank at approximately 08:30; therefore, the time to sink was approximately 30 minutes. The 4 crewmen took a life raft and life preservers and headed for shore. The Carol Ann was not an inspected vessel.

12358 M/V INGER, freighter, diesel powered, 33 gross, 64 ft, wood, 1950, unlicensed, uninspected, draft 4 ft.

Caribbean - east end of Isle Culebrita (Virgin Passage).

Weather - clear, 10-mile visibility, wind east at 10 kts, temperature unknown, sea choppy, sea temperature unknown, 1 ft ht sea E, swell 3 ft E.

At approximately 24:00 on June 23, 1971, forward cargo hold was found to be flooded. When water got into the engine room, the engine stopped. The vessel drifted ashore and broke up with total loss. The crew of 3 abandoned ship in a row boat and reached shore. Although equipped with voice radio equipment, no assistance apparently was requested.

21794 SS BLUE SEAS, freighter, British, steam, 1473 gross tons, 224.5 ft long, 1946, uninspected.

April 3, 1972, 22:50 hours in Vieques Sound, P.R., Caribbean Sea

Weather - visibility 10 miles, wind E at 10 kts, sea calm, 3 ft height from E.

Due to current, vessel struck reef and sank. Crew of eleven entered life boats and were rescued by small craft and helicopter from Navy base at Roosevelt Roads along with a C.G. vessel.

Barges

22276 BARGE #101 (tanker), 6678 gross tons, 360 ft, 1968, inspected.

April 1, 1972, 13:00 hours, mile 186 AHP, Geisman, Louisiana. Mississippi River.

Weather - clear, visibility unlimited, sea calm.

While loading barge with high-density liquid fertilizer, barge broke in half in middle. All 4 on board scrambled for exits. One made it to stairway safely. Two clung to dock wall until helped up. One fell in water and was injured. He was rescued by other people on dock.

32476 BEAN-1, powered barge, diesel, 9 gross tons, 51 ft, 1972, no radio, uninspected.

November 13, 1972, 5:00 a.m., Alamitos Bay, California, vessel in harbor.

Weather - stormy, wind 40 kts, 55 F air, sea rough, 6 ft swell.

Heavy storm resulted in flooding and partial sinking. One person apparently taken off by a "shore boat" - no details. Barge sank when C.G. tried to tow it away on November 18, 1972.

11021 BARGE 255, unpropelled, 2960 gross tons, 250 ft, steel 1969. Inspection certificate June 18, 1969.

August 10, 1970, 19:30, Beaufort Sea, Arctic Ocean.

Weather - patchy fog, visibility changing from .3-.7 miles, small scatter flows of hard ice in the area. Slight NE breeze 5-7 mph. Seas 1 ft. Air temperature 36 F, sea temperature 29 F.

Barge 255 had a leak which had been plugged and she had been pumped out. However, the leak probably recurred. Formerly, the barge

was under the tow of the tub, Mr. Mike. The tow was transferred to the tug. Mr. Richard. about 16:30 on August 10. The barge did not tow straight and sheared widely to left and right. The tow wire was shortened but the barge continued to be uncontrollable. The Captain decided to push the barge stern first after inspecting for additional damage. Realizing the barge might be unstable, the Captain instructed the crew to make tow lines fast in such a manner they could be cast loose rapidly. He also ordered a fire axe to be placed at each line. One man volunteered to station himself forward on the barge as the ice and fog lookout. He and the Captain had previously worked out hand signals for required speed and turns. The Captain had instructed the volunteer that if any trouble developed he would blow the whistle and volunteer was to immediately get back aboard the tug. After they had traveled about 1/2 mile, the barge started a firm but slow roll to its starboard. The Captain blew the emergency whistle, ordered the tow lines cast loose and put the engines full astern. He shouted to the volunteer, instructing him to slide over the side of the barge and that he, the Captain, would pick him up. Volunteer nodded his head in agreement, simultaneously as the barge began capsizing. Just as volunteer was at the edge of the high side of the barge and ready to jump into the water, he slipped and was hidden from view by the capsizing barge. After the tug was clear of the barge, the Captain took the tug around the other side of the barge where volunteer was observed floating motionless in the water among timbers which had broken loose. A crew member of the tug, wearing a life preserver and a life line jumped into the icy water and grabbed the volunteer. Together with other crew members he managed to get the man aboard the tug and immediately carried him into the galley. Most of the man's heavy clothing and flotation jacket had been torn off below his arm pits. He had severe head and body injuries and a large deep cut in his back. Artificial respiration was administered immediately, and a plastic bag was placed over his head with a hose supplying oxygen leading into the bag. Artificial respiration was continued for an hour and 20 minutes. No pulse or other physical signs of life were observed. Following a detailed description of the man's condition and appearance by radio, a doctor declared him dead at 21:00, August 10, 1970. A helicopter from C.G. ice breaker, Stanten Island, arrived shortly afterwards and removed the body. The man was wearing a life preserver when he went into the water.

Fishing Vessels (50 gross or over)

11181 EBB TIDE II, trawler, diesel, 67 gross, 62.2 ft, wood, 1963, uninspected, Master unlicensed. Draft 6 ft forwatd, 8.5 ft aft.

Gulf of Mexico, (Midland: Mexico Beach, Mexico, 10 miles S of U.S. border).

Weather - fog, zero visibility, wind SE at 10 kts, 80 F, sea 2-3 ft, SE, no swells.

While under way in heavy fog--couldn't fix position--depth recorder not working--grounded on Mexico Beach with 4 persons on board. Vessel took on water and later broke up. Coast Guard Station and helicopter rendered assistance. The Coast Guard received message that vessel was aground at 13:20 and in danger of breaking up. At 13:35, aircraft diverted--14:35, USCG Pt. Nowell under way. At 14:55 C.G. received word that Mexican Naval assistance would arrive on scene at approximately 01:00 on 19th--Pt. Nowell secured. At 15:10, USCG helicopter was airborne--arrived at the scene and evacuated 2 persons from on board at 16:20. As seas were now calm, the remaining 2 persons were to await arrival of Mexican Naval assistance. At 09:10 on the 19th, Naval assistance had not arrived, and USCG received word that vessel was breaking up and the 2 crewmen getting ready to abandon. At 12:25, the 2 crewmen safely reached shore and were retrieved from beach by USCG helicopter at 13:44. Method of reaching shore is unknown--probably by raft. Equipment used: 6-man life raft, 1 life ring, 4 life preservers.

11601 FIVE KIDS, FV, diesel, 95 gross, 75.2 ft, wood, 1948, uninspected, Master not licensed, draft 6 ft forward, 7-1/2 ft aft.

Gulf of Mexico, International (block 296, Engine Inland).

Weather - overcast, visibility 5 miles, wind SE at 25 kts, gusty, temperature unknown, sea rough, sea temperature unknown, 10 ft SE, swell 10 ft SE.

While under way, Master felt something strike side of boat and found water boiling up above clutch in engine room. All power went out. Crew of 2 went overboard in life raft, wearing life preservers, and were picked up by United Oil of California standby boat. It is unknown if call for assistance was sent. Hole port side below waterline; 4 ft long x 14 in. wide. Vessel total loss.

31572 NINE, fishing vessel, diesel, 178 gross, 98 ft, 1947, radio, radar, uninspected

January 21, 1973, 0100, Georges Banks (Atlantic) near New Bedford, Mass. Weather - snow, visibility 5 mi., 60 knot wind, 30° air, seas rough, 25 ft waves and swell (cargo of fish).

At 3:00 am on January 21, mate told Capt boat was sinking - water in engine room over flywheel - called all hands on deck (6) and called Coast Guard. Coast Guard helicopter brought pumps. Capt ordered life raft inflated and overboard on a tether. Rough seas, wind, etc. resulted in raft buffeting the side of the ship. All six persons had on life preservers. At ≈ 8:00 am last man was taken off ship by helicopter. Note ships inflatable was destroyed by buffeting replaced by a Coast Guard 7-man raft dropped from helicopter. During helicopter lifting two POB were dunked in water during rescue. Helicopter could not lower pumps because of rough seas. Ship sank at 18:35 after Coast Guard attempt at dewatering.

31567 WAYNE LAURIN, fishing vessel, diesel, 1959, 68 gross, 71 ft lg, radio, radar, uninspected, net 46 tons, width 20 ft.

On January 17, 1973 at 22:30 Atlantic Ocean (International waters) off N. Carolina Coast. Weather - clear (night) 1-3 knot wind, 55° air, sea "good", 49° water, ≈ 1 ft swell, (calm)

Vessel was in collision with larger vessel (suspected to be a Greek Freighter) 10 ft of bow sheared off. 5 persons on board were saved - life raft and life preservers used -- had 6 man inflatable raft and 5 approved preservers.

CB radio used for distress call issued after collision - another FV relayed to Coast Guard.

Crew anandoned ≈ 20 min. after collision, sank 10 min. later, 20 min. later crew picked up by another fishing vessel then transferred to Coast Guard.

31626 SALTESEA II, fishing vessel, diesel, 117 gross, 107 ft long, radio, radar, not inspected, 18 ft wide, 9 ft depth, (wood hull--ex-subchaser), not compartmented.

11:43 EST, 10/15/72, Atlantic Ocean about 4-1/4 miles from Chesapeake Light Tower.

Weather - clear, visibility 12 miles, wind 40-50 kts, gusty, sea rough, 15 ft, no data on temperature, estimated air temperature 58 F.

Vesell equipped with VHF radio--inoperable--and CB radio.

At about 11:15 bessel became sluggish while under way and was found to be flooding. Pumps were on. The Captain ordered preparations for launching skiff and called another FV and notified it of the problem--about 5 minutes later, ship lost power (4 persons on board with life preservers). The Captain tied down wheel and vessel rolled over--he went out the pilot house window. He grabbed a wooden ladder for additional flotation as ship sank. He saw one other crew member in water (motionless). Skiff was floating right-side up (loose). Nearby vessel (about 4 miles) saw Saltesea capsize--called Coast Guard and attempted rescue. Approximately 20 minutes later, Captain rescued. One person was seen in life preserver--on rescue attempt, body slipped out of preserver and not immediately recovered. Other personnel apparently slipped out of their life preservers and drowned. Life preservers were approved-type but may not have been in good condition. Two bodies later recovered--one lost.

31653 M/B PINTA, fishing vessel, diesel, 65 gross, 62 ft long, 1954, radio, radar.

January 14, 1973, about 2 a.m., 17 miles SE of Port Mansfield, Gulf of Mexico (Texas).

Weather - overcast, 10-mile visibility (night), wind 5-6 kts. 50 F temperature, 50 F water temperature, 2-3 ft waves.

At about 6:30 a.m. on January 13, ship struct submerged object--vibration noticed but no apparent damage. On January 14, early morning, ship began listing. Pumps started--couldn't keep up--power lost--"mayday" sent. At 5:45, Harbor Master relayed "mayday" to Coast Guard. Two persons on board abandoned ship using raft and life jackets and kept the raft close to the ship by holding onto the side until the ship sank. They were picked up from the raft by Coast Guard helicopter at 07:21. Coast Guard reports flare used during pick-up operation.

21892 FV VIKING KING, diesel, 122 net tons, 87 ft long, 1969, uninspected.

September 3, 1971, 10:00 a.m. near Billings Head, Alaska, Bering Sea.

Weather - overcast, wind NE, 35 mph, gusty, water 12 ft, NE

While underway, the vessel was noticed to be rolling sluggishly. After an hour of indecision, the Captain headed for land. Two radio distress signals were sent and acknowledged by nearby vessels. All hands were awakened and warned of the boat's condition. Until now, no life-saving precautions had been taken. One man went after the life jackets, but the boat heeled over sharply and prevented him from doing anything but save himself. All hands (4) abandoned ship, one with a life jacket, one with a life buoy, and the other two trying to grab the crab pot buoys on deck. The inflatable rubber raft became entangled in the boat and did not surface for some time. The two men without life preservers drowned before the life raft surfaced. The other two survived to get into the life raft from which they were rescued by other fishing boats.

21985 FV NORTHERN LIGHTS, diesel, 64 tons, 61.6 ft long, 1958, uninspected.

1200 pm, May 7, 1972, Loran Reading 2900 line on 3H3, Gulf of Mexico.

Weather - squalls, visibility unstable, wind variable 25-35 kts, 60 F, water rough, 6 ft SE.

While at anchor in ocean, anchor line became entangled with underwater parts of boat holing bottom. Water entered and cut off electric power and radio. Mud-pot flares lit, but did no good. Vessel capsized. Two persons on board used life raft and life jackets, remained in water 6-1/2 hours until rescued by passing trawler.

22017 FV MARY S LEWIS, diesel, 66 tons, 93 ft, 1891, uninspected.

May 9, 1972, 1 a.m., 5-6 miles east Sand Shoal Inlet, Atlantic Ocean, near Oyster, Virginia.

Weather - overcast, wind ESE, 12 kts, 54 F, sea rough, visibility 0-3 miles.

Due to weakened condition of vessel and heavy seas, water was taken on and vessel capsized. Life raft was on board but not used. Four persons on board used life preservers and clung to floating debris. They were rescued from water by Coast Guard helicopter after 4 hours of searching with flares, cutters.

31337 SKYLARK, diesel-powered fishing vessel, 64 gross tons, 62 ft long, built 1954, equipped with radio--no radar.

December 20, 1972, at 2:30 p.m., CST, 8 miles north of Brazos, San Diego Pass, Gulf of Mexico.

Weather - partly cloudy, visibility 3 miles, wind 16 kts, gusty, air temperature 58 F, sea choppy, sea temperature 53 F, 5 ft waves and 6 ft swells.

There were three crewmen aboard the vessel. At approximately 1 p.m. on December 20, the crewmen discovered water flooding in the hall. The pumps were started but the water came in faster than the pumps could handle. The Captain headed the vessel toward shore and toward more shallow water; however, his efforts failed to keep the vessel afloat and it drifted on the beach. The crew used both life jackets and life raft to arrive safely ashore. The details of the report are not precise. It is presumed that the vessel was grounded a relatively short distance from shore. Vessel was indicated to be a total loss.

31164 SAMMY LEE, trawler, 76 gross tons, 68 ft lg, diesel powered, built in 1954 equipped with radio without radar.

December 16, 1972 at 1600 local time, about 90 miles south of Freeport, Texas, in the Gulf of Mexico.

Weather - partly cloudy, visibility unlimited, wind 30-35 kts, gusty, air temperature 65 F, sea conditions rough, 20-30 ft swells and waves. Sea temperature 75 F.

The ship was equipped with life rings, life jackets, and a life raft. There were three crewmen aboard. Vessel started taking on water while under way. Pumps became clogged and the vessel finally sank. The Sammy Lee was on a fishing trip at the time of the problem when the Captain discovered they were sinking. He sent a request for assistance on the Citizen's band radio at approximately 8:30. He contacted the Gulf King, another fishing vessel, and stated they expected to abandon the ship in approximately 45 min on a rubber life raft. The Captain estimated that they had approximately 1 hour to abandon the ship. The life raft was a 5-man raft, not approved by C.G. Crewmembers abandoned ship by use of the life raft. After boarding the life raft, they were overturned by a great swell. Crewmembers regained the life raft and then returned to the Sammy Lee for provisions. Crew members were on the life raft from approximately 10 o'clock Saturday, December 16, until Tuesday at $\approx$ 1500 on December 19. During that time C.G. search planes were sighted both on Saturday and Sunday; however, they were not able to attract the attention of the C.G. planes. Flares, flags, and a fire on board the Sammy Lee was used to attract attention. Crew members were rescued from the raft by another fishing vessel, the Wahoo.

10054 CAPTAIN WES ROBINSON, FV, diesel, 146 gross ton, 104 ft, steel, 1947, uninspected, Master not licensed.

July 17, 1970, 00:30, Gulf of Mexico International, Block 66, East Cameron.

Weather - visibility, 8 miles, south, southeast wind, light breeze 5-10 kts, 70 F, sea calm, no height, no direction, swell 3 ft SE.

The vessel started to take on water from an undetermined cause, probably failure of the caulking of the cargo hold and engine room. The vessel's 2-1/2-inch bilge pump was not capable of controlling the flooding. When the water level reached sufficient depth to cause the failure of the bilge pump and main engine, the vessel was abandoned. There were 3 POB the vessel at the time. Life jackets and one life boat were used by the three persons. The trawler, Miss Ella Mae, later picked up the crew from the water. There were no injuries in this casualty. The vessel was a total loss. The vessel had no radio and therefore could not call for assistance.

10068 JEANNIE B, FV, diesel, 65 gross ton, 61.6 ft, wood, 1953, uninspected, master not licensed by C.G.

June 16, 1970, 21:30 CST, Gulf of Mexico International. Texas.

Weather - partly cloudy, visibility 12 mi, wind SE at 15 kts, 86 F, sea 4-5 ft to NW, swells 4-5 ft to NW.

On June 16, the vessel was making a run in shore and hit a floating tree on the starboard quarter of the boat, causing the boat to take on water very fast. The operator started both the 1-1/4-inch bilge pumps but water came into the boat faster than the pumps could pump it out. He headed for the shore hoping to beach the boat before it could sink. The C.G. could not be notified as the main radio quit working the day before. However, the operator tried to contact another boat on the CB radio but was unable to make contact. At about 19:00 water got over the main engine stopping it, but the gasoline auxiliary bilge pump was still pumping. The operator put the anchor over to hold the boat so that preparations could be made to abandon the vessel. The operator told his

rig man to get the raft and life jackets ready. They took the raft lashed to fish-hold hatch covers and two ring buoys to the raft and each of the two men aboard put on a life vest. They stayed on the afterdeck until the decks were awash and the boat took a heavy list to the starboard. At about 20:30 on June 16, they put the raft overboard and started to get on the raft. The seas were rough and threw the raft alongside of the boat, throwing the rigman against the bulwarks and back on the raft. The operator then pushed the raft clear and the raft started drifting. At about 21:30 on June 16, the boat rolled onto its side and sank. The rigman complained of pain in his back and claimed that he could not stand much more of these seas. The two men drifted all night and about 10:50 a.m., June 17, drifted onto the beach about 9-10 miles south of the Colorado River. A ranch house was near and the two men walked to it. The ranch employees radioed their employer and he flew them to the U.S. C.G. station, Port O'Connor, Texas. The vessel was a total loss. The rigman was hospitalized for injuries. At the time of the collision the seas were 4-6 ft high in swells. They were breaking at the top some with a little foam. The raft had been mounted on top of the cabin. They used hatch covers and other items to beef it up. These included life rings, apparently, and hatch-cover lids.

<u>10216</u> SHANTY QUEEN, FV, diesel, 108 gross tons, 70.3 ft, steel, 1970 uninspected, master not licensed by C.G.

August 11, 1970, 18:00 EST, Atlantic Ocean International, 2-1/2 miles off Cherry Grove, Fire Island, Long Island.

Weather - clear, visibility good, wind NE 35-40 kts, gusty. 70 F, sea 8-10 ft, NE, swells heavy NE.

The vessel encountered heavy seas and strong winds and was headed for the lea of Long Island when the lobster hold was found to be full of water. The C.G. was called for assistance, the vessel was unable to get rid of the water and headed for the beach hoping to ground. The vessel sank approximately 2-1/2 miles off Fire Island and approximately 10 fathoms of water. Crew of 4 abandoned vessel wearing life jackets in a 6-man raft. Crew was rescued from life raft by a C.G. helicopter. Vessel was total loss. No injuries from this casualty. No information on amount of time required for C.G. helicopter to reach the crew in the raft.

Fishing Vessels (under 50 gross)

31318 LAZY JACK, fishing vessel, 7 gross tons, 42 ft long, equipped with radio, no radar, diesel, built 1935, uninspected.

November 19, 1972, at approximately 3 p.m., mouth of the Merimack River, near Ipswich, Massachusetts.

Weather - clear, visibility 5 miles, wind 15 kts, air temperature 36 F, sea choppy, approximately 8-ft waves and/or swells.

The Lazy Jack was returning from seaward, with 3 crew members aboard, and entering the mounth of the Merimack River. While crossing the bar in the mouth of the river, an 8-ft sea built up the stern and the Lazy Jack broached and laid over on her starboard side and then sank. Persons on the beach saw the casualty and called the Coast Guard. A Coast Guard cutter came and picked up the three crew members. One crew member was picked up from the Lazy Jack's 14-ft life boat, one was clinging to the cabin roof, and the other was in the water holding on to a life jacket--all three were using life preservers but one did not have his properly donned. The report does not provide information on the precise time of broaching and sinking; however, the timing must have been short because the first wave laid the Lazy Jack over to starboard and the second wave when over the top. Following this, the ship was pounded on the surf and broke up. The ship was not an inspected vessel.

30279 BERNADETTE, fishing vessel, 32 gross tons, 45 ft long, built 1945, equipped with radio, uninspected.

September 9, 1971, at approximately 4 p.m., at Laguna Caratasca, near Honduras.

Weather - overcast, hurricane winds, visibility poor (0-3 miles), wind 80-90 kts, sea heavy, air and water temperature not recorded (Hurricane Edith).

Vessel was leaking and while being toward harbor it broke up and sank. Two persons on board--one was taken aboard the towing vessel just prior to sinking, the other was rescued from the water--both wear life preservers. No other details on method of abandonment or equipment used.

31367 SIAH II, fishing vessel, 9 gross tons, 32 ft long, built 1917, equipped with radio, no radar.

September 12, 1972, morning, at Hess Harbor, Juno, Alaska.

Weather - clear, visibility 10 miles, wind 15-20 kts, sea calm.

The vessel was claimed to have been damaged by a large fishing vessel, and upon examination it was found that planks had been torn loose on the port side below the water line. The vessel floundered and sank with a 3-man crew aboard. The survivors abandoned ship using life jackets and a skiff. There were no details as to the method of abandonment.

31370 LADY FAME, fishing vessel, 48 ft, 40 gross tons, built 1967, equipped with radio and radar.

December 24, 1972, 5:45 PST, Pacific Ocean, near Eureka, California.

Weather - clear, visibility 10 miles, sea rough, 30 ft seas, 30 ft swells, winds gusty, water temperature 46 F, air temperature unknown.

The Lady Fame was approaching the sand bar (Eureka), and on passing the bar, ran into heavy seas which caused it to capsize. There were 4 persons on board. After capsizing, at approximately 5:45 a.m., the vessel drifted up-side down and all 4 persons on board were able to climb onto the bottom of the over-turned craft. At 11 a.m., all four were rescued by the Coast Guard--apparently, they were not wearing any kind of lifesaving equipment. There were no details as to how the Coast Guard was notified of the casualty.

12466 NORA C, FV, diesel, 11 gross tons, 35.1 ft, wood, 1942, draft 2 ft forward and aft, uninspected, Master unlicensed.

Pacific Ocean, approximately 3 miles S of Humbolt Bay, 40°42' N 124°18' W, February 19, 1971, 09:45.

Weather - clear, visibility 3 miles, wind SW at 10 kts, gusty, temperature 50 F, seas medium warm, 10 ft S, swell 15 ft SW.

Vessel started to leak, apparently due to loose water--cooled muffler. Bilge upmp didn't work--radio inoperative. Vessel listed and slowly sank but 3 crewmen taken off by F/V Frankie Bay II and transferred to C.G. 36515. Crew did not enter water and did not use lifesaving equipment.

12472 F/V FALCON, fishing vessel, diesel, 43 gross, 4018 ft, steel, 1961, draft 6 in. forward, 8 in. aft, inspection NA, Master unlicensed.

Marmot Bay (1-1/2 miles NW Hanin Rocks), August 13, 1970, 0600 ADST.

Weather - overcast, visibility 1 mile, wind ESE at 12-20 kts, 48F, sea light chop, 38 F, swell 4 ft light, ESE.

While under way, the vessel started to list, possibly from loss of water in crab tank. Master sent "mayday" when he realized vessel would capsize. Mayday received by Coast Guard Station Kodiak, MV Sea Giant, MV Nordic, and MV Pacific Apollo, but no position received. Lifesaving equipment: 5 vests, 1 ring, 1 4 ft inflatable raft--all C.G. approved. Raft successfully inflated, launched, and loaded. Twelve persons on board--one person jumped into water without life preserver and apparently struck in head by propeller and sank, the other swam to raft. At 06:10 the Falcon capsized and sank. By 06:16, 9 persons had managed to climb aboard the raft and 2 clung to life lines on the side. At approximately 07:00 all 11 were rescued by passing fishing vessel F/V Gertrude. At approximately 07:11 another passing vessel, A/V Nordic, relayed location to Coast Guard Station Kodiak--11 saved, 1 lost. At approximately 08:18, August 13, 1970, a C.G. helicopter removed body from water--death due to severe head injury.

12258 SFV, diesel, 42 gross tons, 49.9 ft, wood, 1952, uninspected, not licensed.

April 16, 1971, 06:30, Gray Harbor Bay, Washington.

Weather - clear, visibility 6 miles, wind 40 kts from 045°, gusty, temperature 45 F, sea 15-20 ft WNE, swell 15-20 ft WNW.

The vessel had just cleared buoy No. 8 out of Westport, Washington, into Grays Harbor when a sneak breaker pitched it onto the extension of the jetty. The life raft was immediately inflated and the 3 crewmen got aboard. A passing sport boat, the charter vessel Tallyho, picked up the men within 5 minutes. The automatic pilot failed causing the steering chain to break and the vessel went out of control and collided with Chevron Oil Company T platform before the operator could stop the engines. There are indications that all persons on board may have been intoxicated; however, there is insufficient evidence to support this.

33026 NORWESTER, fishing vessel, 10 gross tons, 37 ft long, wood, no radio, uninspected.

April 18, 1973, Atlantic Ocean, about 32 miles from Miami, Florida.

Weather - partly cloudy, visibility 8 miles, wind 16 kts, 5-ft seas.

Mooring lines became tangled in screw, planks separated on bow. Two persons on board abandoned ship using cabin top for flotation--one saved by being washed ashore--1 lost. Two life preservers aboard reported not used. Vessel sank approximately 30 minutes after abandonment.

30813 FRISCO, fishing and freight (ex-Navy LCM), 26 gross tons, 10 tons net, 46 x 14 ft, diesel, built 1944, uninspected.

October 24, 1972, 1:58, Old Harbor Kodiak Island to Kodiak, Alaska.

Weather - clear, wind 15-25 kts, seas 4-5 ft, temperature 38 F, water temperature 45 F.

One person on board while vessel was enroute from Old Harbor Kodiak Island to Kodiak, Alaska. Distress message was received by another vessel and relayed to the Coast Guard at about 1:58. A Coast Guard helicopter sighted an empty rubber life raft floating about 500 yards from the vessel. The vessel sank at about 2:02. No crewman sighted. It was presumed that the man aboard attempted to launch the life raft but it drifted away. The body was not recovered.

30523 #422, fishing vessel, 18 ft, gasoline powered, 1956, uninspected.

July 24, 1972, 04:00, Coos Bay, Oregon.

Weather - clear, visibility 8-12 miles, night, wind 5 kts, sea 4-ft swells, temperature 56 F, water temperature 48 F.

Vessel with 2 persons on board was returning to Coos Bay, missed the entrance to the channel and ran into shallow water. A wave came over the stern and capsized the vessel at about 04:00. A shore-line notification that the vessel was overdue was made to the Coast Guard at about 03:45. One person was wearing a life preserver and managed to stay afloat and was picked up by another fishing vessel. One person without life preserver was lost--Coast Guard searches unsuccessful.

30899 PEREGRIN II, fishing, 35 ft, 11 gross tons, 1947, radio, uninspected.

September 16, 1972, 4:30 p.m. in Horton Cove, south of Haines Alaska.

Weather - clear, 25-40 kt winds, gusty, 40-50 F air, sea rough 6-8 ft.

The vessel had been loaded with fish and began taking on water. There was 1 POB. The operator maneuvered the vessel to the beach before the engine stalled. The vessel was severely damaged by the wind and waves for four days. The operator was apparently able to get off the vessel in an aluminum punt (8 ft). No indication on use of life preserver.

12305 GULF RANGER, shrimp trawler, diesel, 48 gross tons, 62 ft, wood, 1951, uninspected, master not licensed by C.G.

April 4, 1971, 04:30 CST, Gulf of Mexico, two miles south of Bob Hall Pier, Padre Island, Texas.

Weather - visibility 2 mi, wind SE 10-12 kts, gusty, 60 F, sea sloppy, 4-6 ft SE, swell SE.

While proceeding, the boat ran aground on a sand bar. The crew of three were unable to get the vessel off. The master attempted to contact C.G. but the radio was inoperative. They then rode the vessel in the surf onto the beach where it grounded. The captain and the two crew members donned life preservers and launched a life raft and went to shore. The boat subsequently was pounded in the surf and was regarded a total loss. All three members of the crew used the life-saving equipment that was available. The master and one crew member rode the raft onto the beach to try to get help. The third man remained on the vessel wearing his life jacket. Later when the vessel started laying heavily on her side, he went over the side into the water and reached the shore wearing his life jacket.

10015 SPANIEL, SV, gasoline inboard engine, 31.5 ft, no built in floatation, wood, 1952.

July 3, 1970, 13:50 PDT, Pacific Ocean, 10 miles S of the mouth of the Quillayute River.

Weather - sky was overcast, visibility 10 mi, wind NW at 10 kts, seas 3 ft swells from the NW.

At 10:00 PDT, July 3, 1970, the Spaniel departed La Push, Washington for fishing. There were two POB. At approximately 13:50 the vessel was running south and about 10 miles south of the mouth of the Quillayute River and operator was aft tending to the fishing gear. Other person was in cabin. A terrific thump from somewhere back aft was heard. Water was flooding the vessel so quickly the single bilge pump could not handle the flow. Attempt was made with a citizen band radio but to no avail. Both men took to water in an 8 ft, 2 seat, wooden dinghy just as the vessel sank. They did not have time to don life jackets, but they took two life jackets with them and put them on after abandoning the vessel. Approximately 20 minutes after abandoning the vessel, a large wave capsized the skiff, spilling the two men into the water. They remained in the water clinging to the skiff until the fishing vessel Leonard approach at 15:00 PDT. At approximately 14:15 while west of Destruction Island, Washington the operator of the Leonard had spotted a styrofoan ice chest floating in the water. He continued on a northerly course alert to the possibility of a vessel in trouble. The two men, exhausted, had been unable to hold onto the skiff any longer. One man was found floating face down in the water. The other man was retrieved from the water with much difficulty. C.G. was notified and they proceeded to the scene. The Spaniel sank. The loss of life was due to the long period of time the men had clung to the capsized skiff in the cold water before help arrived.

Tugs and towing vessel

11128 JANE JONES, tug, diesel, 146 gross tons, 96 ft, steel, 1916 Inspection certificate not available, operator not licensed, draft unknown.

December 17, 1970, 12:10, Intracoastal Waterway (mile 238.5, Calcasieu River lock.)

Weather - clear visibility 2-5 mi, wind NW at 3-5 kts, 75 F, sea calm, W, no swell.

While trying to proceed into lock, Jane Jones was stopped by the current. The leading barges of a following tow rode up on the Jane Jones and pushed it underwater, causing it to sink. The crew of six escaped to the barges being pushed by the Jane Jones and did not enter the water.

30418 CONNEE, tug/dredge, 12-1/2 gross tons, 36 ft lg, 1936, radio, uninspected.

July 20, 1972, 12:30 EDT, in Tampa Bay, Florida

Weather - clear, visibility 10 miles, wind 6-8 kts, gusty, 85 F air, sea choppy, 2 ft waves.

Tug was found to be taking on water at approximately 12:30 on July 20, 1972, and the POB started the pumps and headed for shallow water. The tug was grounded about 300 yds off shore, the POB waded into shore during low tide. No data on use of survival equipment.

31489 BLACK SHEEP, tug, diesel, 25 gross tons, 44.4 ft lg, uninspected.

December 13, 1972, 4:30 p.m., Mississippi River, near Mobile, Ala. (just above Great New Orleans Bridge)

Weather - overcast, visibility good, wind 12 kts, air 65 F, river condition not noted.

Tug smoke stack caught on rake of a moored barge, vessel listed due to current and started taking on water through galley door. Three POB climbed from tug to barge. Tug continued to take on water and sank in 80 ft of water in about 2-3 minutes. Life-saving equipment not used.

31632 MISS DOT, towboat, diesel, 69 gross tons, 59 ft long, 1951, radio, uninspected.

July 21, 1972, at 1:30 a.m. CDT, Marsh Island Area, E. Cote Bay, near Balwid, Louisiana.

Weather - overcast, visibility 3 miles, wind 8-10 kts, sea 3-5 ft, temperature not recorded.

Towboat was attempting to maneuver 2 barges when it grounded on a reef. Hole opened in bottom and vessel sank in 12 ft of water. Nearby tug removed 4 persons on board. No details on rescue. Apparently no life preservers or other lifesaving equipment used.

22314 JO ANN, tug, diesel, 12 tons gross, 36 ft, 1938, uninspected.

May 4, 1972, 3 p.m., 1/2 mile SE of Pinto Island, Mobile Bay, Gulf of Mexico.

Weather - clear, visibility 3 miles, wind SE 5 kts, sea calm, 2 ft SE, temperature 80 F.

While under way in shallow water, the Jo Ann was holed and sank. In settled in shallow water so that the two persons on board were able to be rescued by a Coast Guard helicopter.

11988 RAFAEL BERMUDEZ, tug, diesel, 21 gross tons, 42.3 ft, steel 1948, uninspected, Master not licensed by Coast Guard.

April 29, 1971, 20:00, Atlantic Ocean International, 500 meters off Picua Point, north coast of Puerto Rico.

Weather - clear, visibility good, wind ENE, swell 5 ft ENE, wind 20 kts, sea calm, temperature unknown.

While under way from St. Thomas Vergin Island to San Juan, the motor of the vessel failed and the vessel drifted onto the reefs. Fishermen nearby in a small row boat came to the aid of the crew. The crew did not go into the water--no lifesaving equipment was used. There were 3 persons aboard at the time of the casualty. The vessel was later refloated.

22268 M/V T-TRUC #1, diesel, 14 gross tons, 62 ft, 1957, uninspected.

May 9, 1972, 12 p.m., light 24 SW Pass, Near Chevron Facilities, Mississippi River.

Weather - fog, 1/4-mile visibility.

The tub, T-Truc #1, collided with a large freighter, continued down river, and capsized. After the collision, the 3 persons on board tried but could not launch life rafts due to damage done in collision. They wore life jackets and abandoned ship. One man swam to shore and alerted tug of emergency which rescued the other 2 men.

22238 M/V BARATARIA, towboat, diesel, 64 gross tons, 68.7 ft, 1937, uninspected.

November 25, 1971, 5:00 p.m., Long Island Sound

Weather - overcast, wind NNW at 35 kts, visibility 8 miles lowering to 0 in rain, gale warnings set at 2:25 p.m.

While underway, boat received heavy weather damage and began sinking. While trying to launch life raft, one of four POB was swept overboard with raft and is still missing. A diesel fire was lighted on bow of boat as distress signal. Red flares were also fired which were observed by nearby boats and radioed to the C.G. The three remaining POB abandoned ship in life preservers and tied together. They used a water-proof flashlight to signal a C.G. helicopter which lowered a basket and rescued them.

30572 FREDERICK M. Tug, 17 gross tons, 45 ft, radio, 1946, uninspected.

September 16, 1972, 09:45 about 1000 yards from Robbins Reef Light in New York Harbor.

Weather - clear, 10 mi. visibility, wind 5 kts, 73 F air, calm sea.

Vessel was underway when the stern tank started to fill with water and the stern end started to sink. The tug was headed for shallow water - the keel slid into the mud and the vessel listed and began to capsize slowly. There were four POB apparently taken off by a C.G. vessel. Assistance was also offered by other vessels.

31148 INDIAN, tug, sinking at Hess Terminal on December 6, 1972. 75 gross tons, 75 ft lg, built 1897, uninspected.

Cove 600, Patapsco River.

Weather - overcast, rain, visibility 1-2 mi, winds gusty, air temp. 40°, seas calm.

The tug was at the dock and had previously been damaged by a grounding. The tug was being loaded and everything seemed normal until the engineer went into the engine room and found that water was coming over the floor plates, and from that time until the tug sank was approximately 2-3 minutes. Subsequent investigations showed that water had been coming on aboard for approximately 15 min. prior to the sinking. The engineer called the Captain and the Captain called by radio to the C.G. before the tug went down. The fireboat was brought in by the C.G. to assist in pumping out the tug, but it sank before either the C.G., or vessel, or the fireboat vessel arrived. There were four POB and apparently the four persons simply walked off the ship onto the dock. There is no indication of the use of any life-saving equipment.

31405 RAY KAY, tow boat, 62 gross tons, 47 ft lg, equipped with radio.

January 15, 1973, 13:45 local time, at the Shell Oil Company dock at Norcoe, Louisiana on the Mississippi River.

Weather - clear, visibility 4 mi, river calm.

The tow vessel was attempting to move a barge when the towing wire broke and the towing vessel healed over, or tilted, took on water, and sank. The three POB towing vessel jumped onto the barge. There is no indication of the use of any other life-saving equipment.

11693 TEXACO NEBRASKA, tanker, steam 13,251 gross tons

URSA, tug, diesel, 146 gross tons, 82 ft, steel, 1944, uninspected. Operator not licensed, draft 7' 6" fwd, 8' 6" aft.

November 14, 1970, 03:35 CST, Texaco Island Intersection, Intercoastal waterway.

Weather - clear, visibility unlimited, wind NW 20-25 kts, gusty, 50 F, sea conditions unknown.

The Ursa was assisting another tug, the Havoline, to take the Texaco Nebraska out of her berth. Upon moving to the port quarter of the Texaco Nebraska, the master of the Ursa called the pilot on radio requesting him to take it easy. On hearing this, the pilot immediately ordered stop at 03:30 CST. The Ursa tipped onto her starboard side and sank at 03:33, after the hawser was cut by personnel on the stern of the Texaco Nebraska. The Ursa had been pulling the Texaco Nebraska, with approximately 200 ft of 7-1/4 " polydacron hawser. When the tug started to capsize, the master attempted to reach the general alarm switch. Water came quickly into the pilot house. Two deck hands assisted the master from the pilot house. With a life jacket and a wooden grating he was able to stay afloat and rescued by the tug, Havoline. After the tug capsized, five men were seen in the water as well as the life raft and some life rings. At least three life rings were thrown from the Texaco Nebraska. It is unknown whether all the crew that were in the water were wearing life jackets or had life rings. However, all five were rescued safely. One crew member on board was trapped in the vessel as it sank. He, as well as several others of the crew, probably were asleep when the vessel capsized. At approximately 16:00 CST on November 15, the Ursa was salvaged and the crew man's body was found inside the starboard forward room. Death was caused by drowning. Apparently the other crew members who were in the water, at least three of them were on the life raft, possibly two were in the water with life rings. The Ursa was involved in a similar casualty on May 19, 1967, in which she capsized resulting in loss of life.

11694 DORCHESTER, tug, diesel, 20 gross tons, 42.3 ft, steel, 1945, inspection certificate not applicable, master licensed by C.G.

November 28, 1970, 19:50 EST, Delaware River, about 1-1/2 miles SE to the entrance to the Chesapeake and Delaware canal in Delaware Bay.

Weather - clear, visibility limited only by darkness, winds ESE 5-10 kts, 65 F, sea, calm.

The tug Dorchester was towing the U.S. Navy barge YREM-4 northbound in Delaware Bay. The tug and the barge collided with the southbound freighter Ritva Dan. As a result the tug sank. First the tug rolled about 50^{o} to the starboard and the bow of the barge went under water. The barge then pulled the tug back to about 60^{o} to port and the tug started to fill with water. All the while the captain was still at the wheel house. The captain climbed out of the starboard door and went looking for one of his crew members. The tug kept sinking and the master kept looking for the crew member. He then heard a voice screaming "throw me a life jacket" and he observed the crew member struggling in the water about 50 ft astern of the tug. Another crew member also spotted the crew member in the water and shined a flashlight on him. The man was right in the middle of all the life preservers and 5-gallon cans that had fallen overboard when the tug started rolling. However, the man in the water got panicky and continued calling for help. The master climbed off the tug and onto the barge with the other crew member, and they both kept hollering to the man in the water and he continued to holler back. finally, after a few minutes, his voice stopped and he disappeared under water. When the tug started sinking, they cut the bow line and soon the other lines broke or slipped off their bits leaving the barge completely free from the sinking tug. About 5 minutes after the captain left the tug it sank completely below water. Several tugs came on the scene with two C.G. helicopters. They searched for over two hours for the missing crew man but without success. On December 7, 1970, the body was found, partially buried in the sand near Reedy Point, Delaware. The other two crew members were rescued from the barge. Sufficient life-saving devices were available aboard the tug but due to the suddenness of the accident none were used.

Platform - Drilling Barge

30539 MILTON G. HULME, drilling rig, three-leg jack-up type classed as a barge, built 1969, 2302 gross tons, normally manned by a crew of 79.

July 24, 1972, 06:30, approximately 80 miles NW of Jakarta, Indionesia.

The rig was on location when a blowout occurred. The blowout resulted in severe agitation of the water around the rig. All crewmen except 10 were evacuated from the rig by about 07:00. By 07:00 the blowout was out of control and by 12:00 the rig was moving and the spray reached the deck about 40 ft above sea level. By 13:00 the rig was tilting about 45°. About 2 hours later the remaining 10 men were evacuated. There was no fire. Most of the equipment fell into the sea. Twelve persons were evacuated by helicopter and 57 were taken off by a supply vessel that was alongside the drilling rig. The ten men who stayed longer were taken off by helicopter. The inflatable life rafts and life preservers that were on the rig were not used.

21845 M/V LOCO #2, elevating barge, diesel, 43.4 tons, 41.1 ft length, 1966.

May 12, 1972, 06:45, 300 ft E and 300 ft S of NW corner of Block 23, East Bay, Gulf of Mexico.

Weather - rain, hail and high winds, 3 ft visibility, NNW, 72 kts, water choppy, 3 ft variable direction.

The barge was capsized in a tornado. The two crewmen were rescued by the rig boat Billy W.

Miscellaneous

12438 LAFOURCHE, oil exploration vessel, diesel, 198.98 gross, 130.6 ft, steel, 1956, inspection NA, master unlicensed, draft fwd 7 ft, aft 7-1/2 ft.

Gulf of Mexico, East Cameron Area, Block 81, May 8, 1971, 0630 COST

Weather - light haze, visibility 8 miles, wind S @ 5 mph, temperature unknown, sea SSE, swells 5 ft SSE

While backing close to drill rig Margaret, Lafourche hit rig leg (because of lift by swell) engine room flooded, vessel capsized and sank. Four crewmembers escaped using life jackets. No information on removal from water.

12467 EL DORADO, buoy tender, diesel, 12 gross, 38 ft, wood, 1950, uninspected, master unlicensed, draft 3 ft forward, 4 ft aft.

Pacific Ocean, 6-1/2 miles SW of Point Sal, January 8, 1971, 1330 PST.

Weater - clear, visibility 4 miles, wind NE @ 3 kts, temperature 55-60°, sea 8 ft, swell 8 ft SE.

While fishing vessel began to sink, pumps could not cope. Boat sank (caulking had failed). Crew of one rescued by The Gypsy, which was fishing with the El Dorado. Life jackets were available, but no information as to whether one was used.

32163 YSD 71, work boat, diesel powered, 138 gross tons, 104 ft lg, equipped with radio. uninspected, built 1943.

April 15, 1973 @ ≈ 11:30 p.m. EST in Gulf of Mexico, near St. Petersburg, Florida.

Weather adverse, clear moonlight, 15 to 25 knot winds, gusty, 70° air, rough seas -8 to 12 ft.

Vessel under way with two POB, started taking on water, called C.G. - helicopter responded - picked up one man off vessel, one man out of water - both wearing life preservers. Time of events not recorded. There was time to launch an 18 ft skiff with outboard motor - skiff swamped and sank before the vessel sank. Man in water noted that he had to pace his breathing between waves breaking over him.

<u>31720</u> TRUTH, "S" vessel (diving support vessel) 53 gross tongs, 54 ft., 1965, radio, radar, Inspected

February 25, 1973, 4:10 am, Pacific Ocean, near West end San Clemente Island, Weather - clear, 10 mi. visibility, 3 knot, 53° air, sea large swell 4-5 ft, 1 ft waves, ≈ 53° water. 22 passengers, 3 crew aboard.

Vessel underway hit reef - backed off reef and flooded - abandoned ship - vessel sank. No details on events.

Coast Guard helicopter responded to call. 25 POB saved using life preservers. U.S. Navy Underwater Diver team also assisted.

<u>12577</u> NORTHERN DANCER, drill rig crew boat (oil exploitation), diesel, 90.92 gross, 61 net, 83.7 ft, aluminum.

Java Sea (5° 54' S, 107° 20' E : ≈ 30 miles East of Jakarta, Indonesia), December 24, 1970, 0011.

Weather - partly cloudy, visibility 20 miles, wind W @ 5-8 kts, 90°, sea warm, W, 1-2 ft.

The Northern Dancer's certificate of inspection expired June 3, 1969, allowed a total of 40 persons aboard. There were seven crew and thirty-eight passengers aboard when the vessel closed with the M/V Aqueduct in order to exchange materials while the vessels were underway. The Aqueduct was proceeding at full speed and on automatic pilot when the Northern Dancer came alongside. The Aqueduct reduced to 1/4 speed, materials were exchanged, the vessels separated, and the Northern Dancer advanced faster than the Aqueduct. When the pilot houses were abreast, the Captain of the Aqueduct, satisfied that the Northern Dancer was clear, increased speed to 3/4 ahead. When abreast the bow of the Aqueduct, the Northern Dancer suddenly heeled to starboard, then veered to port across the bow of the Aqueduct. The Northern Dancer was struck on the port side aft of the passenger cabins. She heeled, then was struck again at the after bulkhead of the engine room. She completely capsized, swinging around the bow of the Aqueduct, and passed down the port side, bottom up. The Northern Dancer stayed bottom-side up and began to flood. She settled slowly by the stern, and sank stern first at 0044. Many of the passengers were asleep at the

time of the casualty, and survivors awoke when the vessel was hit or when water rushed in. The Aqueduct stopped, then backed to render assistance. Some passengers swam to the Aqueduct, some boarded a life boat which had been atop the Northern Dancer, and some found life buoys (rings). Others were assisted to the Aqueduct by swimmers.

The casualty occurred so swiftly that none of the survivors had life jackets. Buoyant apparatus atop the cabin floated free and was used for rescue of several persons. Inflatable life crafts floated free and remained attached to vessel by lanyards, but did not inflate (lanyards 80 ft long, water over wreck only 30 ft) and were not used in any rescue.

Divers found no bodies outside the hull. Twelve were recoved from passenger cabin, seven from crew quarters. Eight persons were missing, possibly still in sunken vessel. All of the known dead were trapped within the hull due to immediate disorientation and loss of

Of the 45 aboard, 18 were rescued, 19 drowned and bodies recovered, 8 missing presumed drowned. None entered rafts or rings directly from vessel, but from water. At least four on life raft with two others towing it, two with rings, most others (at least nine) swam to Aqueduct. Those with rings also may have swam to vessel.

32120 JOYCE C, supply vessel (MV), diesel powered, 97 gross tons, 96 ft lg, built 1966, equipped with radio and radar, uninspected.

March 23, 1973, @ 2100 to 2115 CST, in Block 310, Main Pass, Gulf of Mexico.

Weather - overcast, visibility (dark) none, wind 25-30 knots, gusty, sea very rough, 10 to 14 ft seas.

Vessel underway with five POB, began taking on water, pumps started, cargo shifted, vessel in trough and listing 60 to 70° - crew prepared for ship abandonment by donning life preservers, life rafts and life rings were put into water. Another vessel standing off 250 ft, vessel sank stern first - took about 10 minutes to sink. All POB retrieved from water by standing by vessel in about 10 minutes. Men were unable to get into the life rafts. Vessel sank about 15 minutes after rolling on side - water entered through hatches and stack vent.

31141 Dredge tender, 15 gross, 12 net, 31 ft lg, 11.5 ft wide, 2 ft deep, 1 ft freeboard, gas engine, 1971, uninspected.

February 27, 1972, 9:30 a.m., Mile 257, Kentucky River near Beattyville, Kentucky.

Weather - clear, 3 kt wind, 30 F air,

There were 2 POB. Vessel was in process of tying up to dock when due to poor practice (tying up with a crane) the vessel capsized. Both POB jumped overboard. They were not wearing life preservers. One drowned and the other swam to shore.

10902 BALBOA, oil exploitation, diesel, 12.7 gross tons, 72.5 ft, steel, 1957. Draft 4 ft fwd, 6 ft aft, uninspected, operator not licensed by U.S. C.G.

October 18, 1970, 03:30 CST, Gulf of Mexico, Block 119, Eugene Island Area.

Weather - clear, visibility unlimited, wind NNE 25-35 mph, gusty, 65 F, seas 8-10 ft NNE, swell 8-10 ft NNE, swell 8-10 ft NNE.

At about 03:00, the operator noticed seas were coming up on the stern of the vessel and that the boat was riding low. He decided that water was being taken into the stern tank through the air vent. As it appeared that boat was going to sink, called for help on Mobil Oil Company radio, and three Mobile Oil vessels responded. There were 3 POB. One was put onto the platform from the boat, then the engine stopped and the bow lines broke. A second crew man jumped overboard wearing a life jacket and swam to the platform. The operator remained with the boat. It turned onto her starboard side, then the operator was picked off by one of the Mobil Oil boats without going into the water. All three wore life jackets, one off by rescue boat, one onto the platform directly, one into water and then onto platform. Vessel sank, total loss. Report stated one life saved with life-saving equipment.

20062 S/V STORMALONG, schooner, diesel, 20 gross tons, 45.5 ft, 1930, uninspected.

May 23, 1972, 3:15 p.m., 1-1/4 mile off Hue Ranch Beach, just south of Kona Village, Hawaii, Pacific.

Weater - clear, 10 mile visibility, wind SW, 5 kts, 70-80F, calm seas, 75 F, 1-2 ft, N swells 1-2 ft S.

While underway, vessel started taking on water, more than pumps could handle. One POB fired three flares and soon had help. Couldn't save ship so abandoned and swam to nearby vessel.

11241 M/V BIG RED, work boat, diesel, 172 gross tons, 93.8 ft, steel, 1925, uninspected, master unlicensed.

August 29, 1971, 15:00 CDT, Gulf of Mexico, Int'l Block 61, Main Pass Area,

Weather - partly cloudy, visibility 5 mi, wind NE at 12-16 kts, gusty, 86 F, sea rough, 6-8 ft, NNE, swell 6-8 ft NNE.

Heavy weather and seas pounded the boat's stern against the offshore structure in Block 299-B, ripping portion of the deck from the transom. Vessel took on more water than the one operating pump could handle and vessel sank as she was trying to make shallow water.

When the deck pulled loose from the hull, master tried to call other vessel, couldn't. Called Company and they called C.G. Tried to lighten vessel and make run for shore. Vessel was listing. Abandoned vessel about 2-2-1/2 hours after leaving structure area. All ten crew wore life jackets. Life raft was used. Crew picked up by B & J after about 20 minutes in the water.

12140 M/V SUPER RED, oil exploitation diesel, 147 gross tons, 100 net, 91'4", steel 1956, uninspected, master unlicensed.

October 28, 1970, 03:00 CST, Gulf of Mexico, Chevron Well Number 27.

Weather - overcast, rain visibility 5 mi, reduced to approximately 200 yds and rain squalls, winds S, 30-35 mph, gusting. Air temperature 65-70 F, sea 8-10 ft S, water temperature 65-70F.

During the afternoon of October 20, 1970, the Super Red departed from the Chevron Oil Company dock for a platform structure

maintenance trip in the Gulf of Mexico. Persons on board were the master, and cook, and a 6-man maintenance crew. The Super Red and personnel performed routine painting and other maintenance to structures in the South Marsh Island and Ship Shoal areas through October 27, 1970. During the evening of October 27, the Super Red arrived and moored stern to platform S-94 in Block 108, Ship Shoal area. The Super Red then shifted from Platform S-94 and about 20:00 hours on October 27, arrived and moored stern to Chevron Well Number 27. After the boat had been moored and at about 21:00 hours, two POB retired to the 6-man berthing area. One man went to the after berthing area and another went to the foreman's stateroom. The remainder of the POB were on the mess deck. At about 02:00 hours on October 28, 1970, one man awoke and sensed that something was wrong. The Super Red was dark, was rolling sluggishly and was down by the stern with a starboard list. He awakened another man and ordered him to get the crew up. Attempting to awaken the crew, he was foiled by water being in the center of the 6-man berthing area. The two men then went to the wheelhouse and couldn't open the water-tight doors due to a starboard list on the vessel and vacated through a wheel-house window. Shortly thereafter another man came to the wheel house and was assisted through the window by the other two. One man then went on to the deck house to release the life float. None of these men were wearing life preservers. One man sounded the vessel's air whistle and both men yelled in an attempt to attract attention from the nearby Platform S-94. One man in the 6-man berthing area was awakened by water splashing in his face. He abandoned the compartment by diving through the open but flooded doorway. Another man in the 4-man after berthing area was also awakened by water flooding the comparment. He too abandoned his position by diving through the after doorway. He had no knowledge of others being in the compartment. Three men attempted to release life float. Boarding seas broke over the vessel, washed the three men overboard and broke the life raft loose. The life float floated free and three men boarded it. They then yelled to two who were still on the bridgeway to join them. However, the life raft floated away with the winds and rough seas. None of the men were wearing life preservers. Breaking seas then washed the two men overboard and the vessel sank stern first. One man reported that he heard the other call out, but he never saw him again. He could not swim to the platform S-94 because of the sea.

He, therefore, swam with the sea toward a lighted unmanned platform about 3/4 mile distance from the Super Red. Reaching the platform he pulled himself onto the lower level where he took refuge behind a caissen until daylight. At about 07:15 hours on October 28, personnel on platform S-94 advised the C.G. that the Super Red had foundered. A search was commenced immediately with C.G. helicopters and cutters as well as commercial helicopters and vessels. At about 10:46 on October 28, a C.G. helicopter spotted the man who swam to the platform and directed a vessel to his rescue. He was taken to a hospital at Borgen City, Louisiana where he was treated for exposure. Life float with three survivors drifted throughout the night. The following daylight they were spotted, having drifted 12 miles downwind and C.G. helicopter took these survivors to the hospital. Search for survivors and/or bodies was discontinued on October 30, 1970. Commercial divers doved to the Super Red on October 31, 1970, but found no bodies. The cause of the casualty was a moderate sea surged over the Super Red stern and flooded the below main deck compartments through open or nonsecured hatches, thereby sinking the vessel. Four persons are missing and presumed dead. The vessel was not secured for heavy seas, therefore, the weather and sea conditions are not considered to be contributing factors in that the master of the vessel was aware of them prior to retiring and should have acted accordingly.

A1.2 Abandon Ship (fire)

Passenger (under 100 gross)

11252 MV TA-MARU-TOO, charter boat, diesel, 15 gross, 46 ft, wood, 1932, uninspected, master licensed by C.G.

January 5, 1971, 10:00, Atlantic Ocean.

Weather - clear, visibility unlimited, wind SE at 18 kts, gusty, 68 F, choppy sea, 3-5 ft.

There was fire from unknown source in engine room. CO_2 fire extinguisher not adequate. The C.G. was notified. Crew of 3 removed from burning boat by another vessel. Boat sank.

30966 CREEL #7, charter fishing vessel, 40 gross tons, 55 ft lg, 1967, equipped with radar and radio, uninspected.

August 16, 1972, 09:00 in Pacific Ocean about 27 miles out of Ilwaco, Washington.

Weather - clear, visibility excellent, 10 kt wind, 60 F air, sea moderate approximately 2 ft.

There were 9 POB and a fire started as a result of a battery explosion in the engine room. Apparently the C.G. was called. A total of 20 dry chemical fire extinguishers were used in attempting to extinguish the fire. The fire was brought under control using the fire extinguishers and water. However, the vessel was sinking so it was towed into shallower water. While it was under tow, it sank. The 9 POB apparently were taken off by the C.G. vessel who was towing the Creel #7. The report indicates that life preservers were used - no details.

21604 GRACEE II, passenger, diesel 23 gross tons, 43.8 ft, wood/fiberglass, 1963, draft 5 ft fwd and aft. inspected 4-22-69, master licensed.

March 25, 1972, Atlantic Ocean, International (Hudson Canyon, 20 mi. SSE Barnegot Light, N.J.

Weather - clear, visibility 20 mi, wind NW at 25 kts, gusty, 26 F, sea rough, 40 F, 4 ft N, swell unknown.

While inbound at 04:00, fire was noticed in the motor box. Master and mate (only 2 POB) ran out the aft door with extinguisher, but couldn't get close enough to engine compartment to pull the release of the fixed CO_2 fire extinguisher system because of the intensity of the fire.

They put the life raft over the side and got into it (British Avon, 8-man life raft, not C.G. approved). They watched vessel burn for 3-1/2 hours before it sank. Oil tanker Esso Chester spotted flares used from the raft, and stood by until crew was picked up by the U.S. C.G. Morganthau. No information on whether C.G. was called by Gra-Cee II or by Esso Chester. Crew did not enter water, went directly from vessel to raft. Vessel was total loss. No injuries.

12340 FLYING SAUCER, converted PT, small passenger vessel, gasoline, 31 gross tons, 67.6 ft, wood, 1945, inspection certification 8-3-40. Master licensed by C.G.

August 25, 1970, 19:05, Beach thoroughfare, 50 ft off Ocean City Yacht Club, Philadelphia.

Weather - clear, visibility 5 mi, winds S at 2 kts, 79 F, sea calm, 73 F, no sea or swell.

Shortly after departing the dock at 19:00 the deck hand switched fuel tanks, his normal procedure. Shortly thereafter a low-grade explosion occurred followed by a general fire in the engine room. The operator, seeing smoke come in from the engine room, immediately discharged the installed CO_2 system and headed the vessel toward the beach. The passengers donned life preservers and jumped into the water. One passenger injured left knee while trying to leave vessel. At this time a C.G. patrol boat in the area came alongside and removed the remaining people from the Flying Saucer and extinguished some smoldering fire on part of the afterdeck. A total of 28 persons were treated for barnacle cuts and were released. After the fire had been extinguished and all passengers accounted for, the Flying Saucer was towed back to the dock. At the time of the casualty there were 105 passengers and two crew members on board the vessel for a scenic cruise in Great Ache Harbor in the Atlantic Ocean along Ocean City Beach. The life preservers and the three ring buoys apparently were used when the passengers went overboard. There were no fatalies in this casualty. Vessel equipped with 122 adult, 40 children life preservers and three ring life buoys

Freight vessels

11867 TRADE DARING, ore and oil vessel, diesel, 15,510 gross tons, 607 ft 5 in, steel, 1955, inspection certificate not available, Master license not available.

March 19, 1971, 00:52, Perth Amboy, New Jersey

Weather - visility 10 mi, wind NW at 20 kts, gusty, air temperature 30 F, sea conditions not aavailable.

While the vessel's bunker tanks were being refueled with diesel oil they overflowed. Diesel oil backed up through a catch basin drain which runs to the double-bottom tank, the catch basin overflowed spilling diesel oil on an operating generator. The diesel oil fumes flashed and the fire spread rapidly due to a supply blower duct above the generator. Flames engulfed the entire engine room and spread to the after superstructure. The fire spread rapidly with such intensity, heat and smoke, that the crew were forced to abandon the aft accommodation and except for the closing of skylights, vents, and air access to the aft accommodation house, were unable to contain the fire. The ship was in danger of explosion because of gaseous fumes in their empty cargo tanks and most of her engineering and her stewards departments abandoned from ship to shore by descending the Jacob's Ladder. At the time of the casualty there were 35 persons aboard. At 01:00 hours two undocking tugs came alongside forward and the ships crew, remaining aboard, began to secure the tugs and cast off lines with the bow. A fire truck arrived alongside but was unable to effectively assist in fighting the fire. The tugs then moved the vessel out from the dock and towed it to an anchorage near Ward Point Bend below Port Perth Amboy. At this time, there were 16 POB. At about 2:40 hours, all these were removed by one of the tugs and transferred ashore. The vessel's engine room and superstructure F burned down and the vessel was considered a total loss. There were no injuries involved in this casualty. No life-saving equipment was used as crew was either able to abandon the vessel directly to the dock or else onto the escorting tug boats.

Tugboat/Towboat

12439 M/V A.E. RUIZ, tug, diesel, 26 gross, 41.2 ft, wood 1942, inspection NA, Master unlicensed, draft 5 ft forward, and 5-1/2 aft.

International Waterway, mile 65, May 9, 1971, 1400 CST.

Weather - clear, visibility 10 miles, no wind, air temperature 85 F, sea/swell NA.

Fire started in engine room. Attempts to extinguish failed. The two crewmen grounded the barge, then the tug, and jimped onto the barge. Both were wearing life jackets, but did not go into water--could not call for assistance, but a speedboat in the area helped by pushing the barge out of the way.

30435 WANDA TROY, towing salvage vessel, 17 gross tons, 36 ft long, built 1947, uninspected.

August 16, 1972, at 4:30 p.m. on Cape Salvador near LaRose, Louisiana (Intercoastal Canal).

Weather - clear, visibility approximately 5 miles, temperature 79 F, sea calm.

One person aboard heard a slight explosion and found the engine room on fire. While he was attempting to extinguish the fire using fire extinguishers and buckets of water, a propane tank exploded. Crewman gave up, jumped into water and swam to shore. Vessel lost. No apparent use of lifesaving equipment.

22003 M/V PALMER GAILLARD, tug, diesel, 199.43 gross tons, 109 ft lg, 1953, uninspected.

December 22, 1971, 16:30 hrs, 9 miles SW Diamond Shoals Light Tower, Atlantic Ocean.

Weather - clear, unlimited visibility , 40 kt wind, NE, gusty, water rough, 15-20 ft NE.

The captain noticed smoke coming from engine room when all electrical steering power failed. He still had a side band radio and sent out distress call. Hawser for towing barge was cut loose. Three #15 CO_2 extinguishers used, but were ineffective. The rubber raft, while being removed from the roof of the engine room was accidently inflated and almost knocked some people overboard. In the inflated position it was scorched by the engine room wall as it was lowered to the deck. When finally dropped overboard, it landed in the inverted position. The heavy seas ripped the painter to the boat and the raft drifted away. Signal flares were then fired. A C.G. helicopter arrived then and removed all 7 POB to land and safety.

11190 LUTHER HERDMAN, towboat, diesel, 366 gross tons, 249 net, 123 ft, steel, 1946, inspection certificate not available, master unlicensed, draft 7-1/2 ft fwd and aft.

January 6, 1971, 08:30, Kanawha River (Mile 6)

Weather - clear, cold--no other data.

Smoke was noticed coming from engine room. Engineers and deckhands unable to enter to start fire pump, or otherwise fight fire due to smoke. Captain notified of this, placed engines on idle, and off watch was called and home office notified. The towboat was abandoned with crew of 8 going onto barges of the tow. C.G. arrived at 09:25 to fight fire and were assisted by the Pt. Pleasant Volunteer Fire Department and other vessels. Only C.G. personnel boarded towboat. Pumps were used to supply water for fire fighting. C.G. also brought foam. Vessel gutted and was a total loss. Vessel not equipped with fixed-fire system. It is unknown what other fire-fighting equipment was on the vessel. All fire fighting was from external sources. Crew did not enter the water. Life-saving devices not used.

Barges

12389 DOW barge #1910 under tow of M/V Thomas Allen, 120 x 35 x 8 ft, steel, built 1963, undocumented, cement barge, 4.5 ft draft forward and aft.

Thomas Allen Tug - diesel powered, 46 ton, 49.1 ft, steel, built 1963, unlicensed, uninspected.

Quarrantine Bay, Louisiana, February 28, 1970, 0645 CST.

Weather - clear, no other condition noted.

Tug was towing barge on ≈ (0' tow line at ≈ 6:45 a.m. Master heard small explosion and saw fire and flames around barge house (maybe struck underwater gas line). Tug cut line and tried to go about to grab the three workers off the barge. One jumped into water and the other two were taken off by a speed boat from one of the rigs (oil/gas?) in the area. Another crew boat picked the man out of the water. Tug couldn't maneuver quickly enought to effect rescue. Crew boats took man to Williams Rig #7. One man had minor burns on face and more serious burns on ears, and minor burns on chest and arms - removed to hospital by unspecified means. All three wore life preservers.

30477 ATC #165, tank barge, 904 net tons, 240 ft long.

July 28, 1972, 9:00 EDT, in Eastern Branch of Elizabeth River, near Norfolk, Virginia

Weather- visibility 3 miles, wink 1-4 kts, 76 F air, seas calm.

Vessel was at dock, pump was started to pump gasoline out of tank when sparks from pump ignited gasoline fumes. There were two POB. They were both burned by flash fire and both jumped overboard into the water. There was no indication of use of life-saving equipment. Both swam to nearby shore locations. They were treated for burns.

32754 MV BYRON, tug

CP-7 Barge

September 28, 1972, Texaco Island Wall #77 Rabbit island Oilfield

Weather - clear 75 F, seas calm, 5 kt wind

Tug and tow barge approached Texaco Island Wall near St. Mary Parish, Louisiana for hot swabbing operations. One man on tug, two on barge. A pipe failed on the well rig while spraying gas concentrate and fire and explosion resulted. Two men on barge went into water, one picked up by tug, the other crew boat. Tug operator and barge man then taken off by crew boat. No life-saving equipment used.

Fishing vessels (50 gross or over)

12423 PROWLER, FV, diesel powered, 90.13 gross, 81 ft, wood, 1960, unlicensed, uninspected, 8 ft. draft forward, 10 ft draft aft.

Haro Strait, Washington, May 9, 1971 - 1145.

Weather - overcast, visibility 5 miles, wind variable, E, 12-15 kts, gust, air temperature unknown, Sea moderate, temperature unknown, height 5 ft, ENE, swell nil.

Vessel caught fire while underway. Used extinguisher and water to control. After ≈ 4 hours, inspection showed vessel taking water in aft quarters and engine room. Vessel took starboard list. Life boat launched with one man standing by. After ≈ 20-30 min, list increased and vessel was abandoned - disappeared within a few minutes. All three crew wore life belts and all survived. There was no indication that voice radio was used to request assistance, as report states no assistance rendered by either C.G. or others.

12461 SAN MARTIN, trawler, diesel, 52 gross, 55 ft, wood, 1950, inspection NA, master unlicensed, draft 4 ft forward, 6.5 ft aft.

Gulf of Mexico, June 17, 1971, 1900.

Weather - clear, visibility 10 miles, wind SE @ 10 kts, temperature 85°, sea calm, temperature 79°, 3 ft SE, swell 3 ft SE.

Fire broke out in engine room. Master used two 15th CO_2 extinguishers, but couldn't extinguish. Crew of two put on life jackets. U.S. C.G. vessel had come alongside soon after fire spotted. Crew of San Martin transferred to C.G. vessel and San Martin burned to waterline, although C.G. also attempted to put out fire. San Martin crew did not enter water.

21744 SEARCHER, fishing vessel, diesel, 94.14 gross tons, 70 ft lg, 1969, uninspected.

April 3, 1972, 10:20 a.m. Bayou La Batre, Louisiana

Weather - overcast, visibility 5 mi, wind E 26 mph, seas rough, East.

There was a fire in the engine room and lifeboats burned before they could be used. There were 3 POB. They donned life jackets. Fishing vessel Golden Dolphin picked up survivors.

21962 ROYAL PACIFIC, fishing vessel, diesel, 489.8 gross tons, 142 ft, 1961, uninspected.

May 28, 1972, 12:00 p.m., 180 miles south of San Diego, Pacific Ocean.

Weather - clear, visibility 4 mi, wind WNW at 10 kts, choppy seas, 4 ft WNW.

While underway to fishing grounds, explosion and fire in engine room occurred. Too intense to fight, all 14 POB entered two power skiffs with life jackets. Rescue made by HH3R 14:36.

22256 ATLANTIC CAPE, fishing vessel, diesel, 84 gross tons, 66.2 ft, 1966, uninspected.

June 26, 1972, 13:00 hrs, 80 miles E of Mantauk, New York, Atlantic Ocean.

Weather - clear, visibility 3 miles, wind SW at 10 kts, waves gentle, 3 ft, swells 3 ft SW.

Fire started in engine room, captain discharged five, 15-lb CO_2 cylinders but did not put out fire. All 4 POB put on life jackets, launched life raft. Smoke was noticed by nearby boat which rescued survivors.

20089 SHANE, fishing vessel, diesel 59 gross tons, 56 ft, 1958, uninspected.

June 21, 1971, 3:15 p.m., Brownsville Ship Cannel, 6 mi. NE of Brownsville Shrimp Basin, Texas.

Weather - clear, visibility unlimited, wind SE at 15 kts, 90 F.

While underway to fishing banks, vessel's generating system caught fire. Master beached vessel and 2 POB waded to safety. C.G. boat picked them up from beach.

11699 SMEJ, trawler, diesel, 98 gross tons, 65 ft, wood, 1967, uninspected, master unlicensed.

February 27, 1971, 07:30, Atlantic Ocean International, 25 mi North of Bahia Nipe, North Cuban coast.

Weather - clear, visibility 7 mi, wind NE at 25 kts, gusty, air temperature unknown. Sea rough 6-8 ft NE, swell 6-8 ft NE.

At about 07:30 the master noticed flames coming out of the engine room. He immediately called to other boats in the area by radio, advising them that he was on fire and to come to assistance. The boat was on automatic pilot so the master tried to extinguish the flames with four bottles of foam. The trawler, Mrs. Muggins, came to his assistance and gave him two additional bottles of foam but by this time the fire was completely out of control. The two crew members then boarded the Mrs. Muggins where they stayed a short distance offshore watching the fire for a couple of hours until the boat went down.

11709 M/V LE ROY, scooner, diesel, 82 gross tons, 79'8", wood, 1925, uninspected, master not licensed.

March 24, 1971, 09:00, Shumagin Islands, Alaska, International Water.

Weather - snow, visibility 1/4 mi, wind NE at 25 kts, gusty, 34 F air temperature, sea rough 4-8 ft NE, swell 6 ft SE.

While crabbing, smoke was noted coming from the engine room. Master went to investigate, but smoke was so dense he couldn't get near to see the source. The two people aboard tried to fight the fire using four extinguishers but the fire burned at a rapid rate. While one continued fighting the fire the other called the M/V Dolphin who responded immediately and headed for the location as it was impossible to extinguish the fire. The two crew launched the skiff and put the outboard motor, oars, and life jackets aboard. They were unable to get to the radio for

further calls. They then abandoned the ship. At 10:00 hours they were picked up by the Dolphin. The position of the vessel was then relayed to the C.G. They stood by the burning vessel until 12:00 hrs at which time the house and afterdeck were completely burned off.

11765 CRIM REAPER, fishing vessel, diesle, 64 gross tons, 67 ft, wood, 1957, uninspected, master not licensed.

February 18, 1971, 05:00 to 06:00, Gulf of Mexicto International.

Weather - overcast, visibility 10 mi, wind SE at 20 kts and gusty, 70 F. Sea rough to 10 ft SE, swell 8-10 ft SE.

At just about daylight the captain passed the engine room and noticed smoke come out. The fire was already spreading and he couldn't get into the engine room. The installed CO_2 system went off automatically but didn't extinguish the fire, possibly because hatches were open and too much oxygen getting to the fire. One other extinguisher was used, but didn't help. The fire pump was burnt and couldn't be used to fight the fire. The fire was out of control so that three persons aboard donned life preservers and jumped into the water. The Flaming Mamie was standing off nearby and the three men swam over to the vessel. The Grim Reaper was so ablaze that the Flaming Mamie couldn't get near. Also the seas were rough. The Flaming Mamie called the C.G. and passed on all details then brought the three survivors to Galveston, Texas.

12106 RICHARD D., fishing vessel, diesel, 65 gross tons, 65.2 ft, wood, 1945, uninspected, master unlicensed.

August 11, 1970, 04:30 to 05:00, Bering Sea, Alaska

Weather - overcast, visibility 5-10 miles, wind 10-15 kts WSW, air temperature 40 F, sea height unknown, sea temperature unknown.

The vessel sustained an engine room fire of unknown origin. At the time the fire was discovered the fire extinguishers could not be reached. The master attempted to reach the life rafts which were folded up on top of the galley but he couldn't get to them. He got far enough that he could reach the bow painter on the skiff which was lashed to the boom guy cable. The skiff fell outward into the water but the crew held onto it and dragged it back to the back deck and put it on board.

At that time there was no need to abandon ship. Because of its light weight and the wind it was kept on the back deck until the crew saw it was necessary to get off the deck because, once in the water, a person couldn't row very hard in a strong wind and it being fiber glass, it drifted pretty much. The smoke started filling the back deck and choking the crew, the master decided to abandon the ship and they got the skiff with four crew members aboard, one had no clothing at all; one had only shorts on; one was fully dressed, and the master was dressed but had no shoes on. The crew member with no clothes had his clothes burned off. The master was the last to get into the skiff. They took the skiff clear of the boat in case the boat exploded and they rowed and were able to stay up in the vicinity of the boat. Then another fishing vessel, the Pacific Fisher, came up and rescued the crew from the skiff. The four crew members aboard, one man was badly burned. None of the crew went into the water. All were saved by getting into the fiber glass skiff.

<u>12022</u> CORAL KING, trawler, diesel, 60 gross tons, 68 ft, wood, 1956, uninspected, master not licensed.

April 24, 1971, 05:30 EST, Gulf of Mexico, International 30 miles due west of Naples, Florida.

Weather - fog, visibility 8-10 miles, wind SW at 7-10 kts, gusty, 75 F, sea choppy, 65 F, waves 2-4 ft NNE, swell 4 ft NNE.

While the auxiliary generator was working and the operator and his one crew man were having coffee, smoke was seen boiling out of the engine room hatch. They ran onto deck and saw the fire and smoke below. The crew man then placed a radio call to other boats that had been fishing in the vicinity for help and the master went below deck and emptied two large fire extinguishers at the base of the flame, but to no avail. They then tried to close off the hatches to try to smother the fire and sprayed with the deck hose until the engined choked down. The Doncelyn, a fishing trawler, the Sea Pearl, and Miss Carolyn came to their assistance. The Doncelyn took two persons off the vessel as the fire was about to force them into the water. It took the

Doncelyn about an hour to reach the Coral King after she heard the distress call. There were no injuries in this casualty. The vessel burned and sank as a total loss. No life-saving equipment was used as the two crewmen transferred directly to the other vessel. Four fire extinguishers and sea water were used in attempting to fight the fire.

10098 D/V TRINITY, fishing schooner, diesel, 60 gross tons, 65.2 ft, wood, 1925, uninspected, master not licensed.

July 11, 1970, 13:30 Alaska Standard Time, Izhut Bay, Afognak Island, Alaska.

Weather - overcast, visibility 3 mi, wind SE at 35 kts, sea very rough, 10 ft SW, swell 12 ft W. No data on water or air temp.

The crew noticed smoke and an investigation found fire in the engine room burning out of control. An attempt was made to extinguish with 15-lb CO_2 fire extinguisher. This was unsuccessful. The crew of three with life preservers abandoned ship in a life raft at 14:30 hours. They were picked up by the cannery tender, Kalikh, and brought into Kodiak. There were no injuries in this casualty. The vessel drifted into Izhut Bay, drifted ashore and burned out. At 13:42 contacted Kodiak airways who contacted the C.G. and others. The fire was out of control at this time.

11892 JIMMY BOY, commercial fishing, diesel, 66 gross tons, 62.3 ft, wood, 1941, inspection certificate 3-1-71, master not licensed.

April 25, 1971, 09:40 PDST, Pacific Ocean International

Weather - clear, visibility8 mi, wind WNW at 10 kts, gusty, air temp 49 F, sea moderate 1-2 ft WNW, swell 5-6 ft westerly.

A fire from unknown source started in the vessel's engine room. The vessel sank as a total loss. Two C.G. vessels on the scene fought the fire. The fishing vessel, Recruit, picked up the three crew members. Fishing vessel, Julia B. assisted in fighting the fire with fire pumps. Three crew members apparently abandoned their vessel in a 14-ft skiff. Three lives were saved with life-saving equipment and skiff. No injuries. No information on request for assistant and time element.

Fishing Vessels (under 50 gross)

30262 PODUNK QUEEN, fishing vessel, 13 gross tons, 42 ft lg, built 1971, eqpd with radio, UNINSPECTED.

July 2, 1972, ≈ 1:00 pm, in the Gulf of Mexico near Freeport, Texas.

Weather clear, 12-mile visibility, wind 12 knots, 90° air, sea choppy, 89° water, waves 2-3 ft.

A fire broke out amidship near engine room. The 2 POB attempted to extinguish the fire without success. They jumped overboard and swam ashore. The vessel continued to burn and sank. The 2 POB were apparently wearing life preservers when they jumped overboard. No details of how far the 2 POB swam.

21873 SEBANUS SEINER, fishing vessel, diesel, 39 tons, 49 ft lg, 1941, inspected.

May 4, 1972, 4 p.m., Izhut Bay, Agrognak Island, Alaska

Weather - clear, wind SE 10-15 kts, water ligth swell 3-4 ft.

Fire started in batteries while underway. Three crew members abandoned ship in skiff and life jackets. They were picked up by fishing vessel, Don't Worry.

31680 MONARCH, fishing vessel, 22 gross tons, 43 ft, radio, wood, 1913, uninspected.

September 21, 1972, 8-9 a.m. Pacific Ocean near Crescent City, California.

Weather - partly cloudy, 5 mi visibility, wind gusty, 20-25 kts, 70 F air, rough sea, 62 F water, 6-8 ft waves and swells.

Monarch suffered a fire on board between 8 and 9 am on September 21 while fishing. Engine failed. Hauled in fishing gear, smoke seen coming from engine space. Radio message sent. Fire extinguishers were used. Two POB abandoned ship by life raft. Fire burned itself out. Persons rescued from life raft by another fishing vessel. Life preservers were available but not used. Monarch sank while under tow by C.G. vessel. No one on board.

11022 LILLIE M, fishing vessel, diesel, 23 gross tons, 46 ft, wood, 1953, uninspected, master licensed by C.G.

September 8, 1970, 09:45, Sapello Sound, Georgia

Weather - clear, wind NE, 5-10 mph, temperatures warm, sea choppy, NE, water temp about 80 F, air temp about 75 F.

There were two POB. At approximately 09:45 fire broke out in the enclosed space between the pilot house and the exhaust stack. The fire was not immediately visible and spread rapidly keeping the men from going to the forward part of the vessel. They could not reach the fire-extinguishing equipment nor could they reach their life preservers. The flames spread rapidly forcing the two to abandon the vessel without the aid of life preservers. The fire also prevented the use of radio-telephone. Approximately 10 minutes elapsed between the time the fire was discovered and abandonment of the vessel. The fishing vessel Footlog sighted the burning vessel and proceeded to her aid. One man was attempting to assist the other who could not swim. The non-swimmer sank. The Footlog rescued one man. A crew member made several dives searching for the other man without success. There had been four life preservers in the wheelhouse. Required fire extinguishers on the vessel had been lost. One man's body was found on September 9. Death was listed as accidental drowning. Two men were in the water approximately 15 minutes before Footlog came to their aid. Despite this short time, one man was unable to save the other man.

22158 MARY JEANNINE, fishing vessel, diesel, 10.49 tons, 38 ft, 1965, uninspected.

May 17, 1972, 06:45, Channel Marker II Dickerson Channel, Galveston Bay, Texas.

Weather - clear, visibility 12 mi, wind N 2 kts, 70 F, seas calm.

Fire started in fuel tanks and engine compartment. Fire extinguishers were used but did not put out the fire. Two POB put on life preservers and abandoned ship. Another fishing vessel picked them up.

12157 KATHY ROSE, fishing vessel, diesel, 19.51 gross ton, 41.6 ft, wood, 1957, uninspected, master not licensed.

May 2, 1971, 00:15, Pacific Ocean International off Port Loma, California.

Weather - clear, visibility 8 mi, wind NW at 15 kts, 65 F, sea slight chop, 2 ft NW, swell 1 ft NW.

While proceeding toward the fishing grounds, one crewman was on watch in the pilot house in the upper deck. The master and the second crewman asleep in the bunkroom on the main deck. The master awoke and smelled smoke. The smoke was coming from bulkheads between the bunk room and the head. The master woke the crewman and pulled board off bulkhead. Flames shot out and fire spread so rapidly, crew was unable to fight it and abandoned ship by taking a skiff. The fire spread rapidly. There were four explosions, 3/4 to 2 hours after the fire started. After the last explosion the boat sank. A Mexican flag tug, Oneka, picked the crew up from skiff at about 04:30. There were no injuries in this casualty.

20776 SILVER SPRAY, cabin motorboat, gasoline inboard, 6 gross tons, 36.3 ft x 9 ft, wood, 1939, draft 20" fwd, 3 ft aft, uninspected, operator licensed by U.S. Coast Guard.

July 28, 1971, 08:50, Cambridge Creek, Maryland.

Weather - clear, visibility 8 mi, wind S at 10 kts, 75 F, seas less than 1 ft. Current negligible.

Vessel prepared for fishing trip after 0730, Five POB, two children, three adults. Vessel underway 08:40, idled to let another vessel pass under bridge. Silver Spray cleared bridge 08:43. Throttle was advanced and there was an explosion in fwd end of vessel, followed by fire around engine 10-15 seconds after passing bridge. Life preservers passed out as cabin was gone and water coming over the floor. Vessel sank in 30 seconds. All but one child floated out of the boat as it sank, child was blown out by explosion and floating 60 ft away. Adult swam to her and supported her by jacket and floating board. In less than 1 minute they were rescued by the Maryland State Police. Child was hospitalized until July 31, 1971 from injuries sustained by explosion. Vessel total loss.

30901 LITTLE FRANCIS, fishing, 44 gross tons, diesel, 48 ft lg, built 1950, radio, uninspected.

November 7, 1972, 2:30 p.m., near Calibogue Sound, near the entrance of May River near Hilton Head, South Carolina.

Weather - clear, visibility 5 mi, wind 15 kts, air 75 F, water 68 F, 1-2 ft sea.

While vessel was shrimping a fire broke out in the engine room. The crew of two persons on board attempted to extinguish the fire with a portable fire extinguisher. They abandoned the vessel and were picked up by another shrimp boat. The C.G. arrived and attempted to extinguish the fire without success. The vessel had drifted toward the beach and was in about 3 ft of water. During abandonment the crew wore life preservers.

12304 LILLIAN C., S/V, diesel, 11 gross tons, 31 ft, steel, 1955, uninspected, master licensed by C.G.

May 21, 1971, 17:00, Pacific Ocean International, 5 mi S of James Island off La Push, Washington.

Weather - partly cloudy, visibility 15 mi, wind NW at 11 kts, Temperature 54 F, sea choppy, 50 F, 3 ft, direction unknown, swell 4 ft west.

The operator saw and smelled smoke at the vessel's engine control panel. Shortly thereafter flames broke out. The operator attempted to extinguish the fire with two dry chemical 2-lb fire extinguishers without success. The fire completely burned the cabin and part of the machinery spaces. One man jumped into the water without life-saving equipment and was rescued by the fishing vessel, Minx. C.G. facilities had been previously alerted, they arrived and brought the fire under control and commenced towing the vessel. As the damaged vessel approached the boat basin at La Push, Washington, it sank and was subsequently raised.

Platform - Drilling Barge

20471 MANNED PLATFORM B, 2 decks above waterline, 51 ft awl, top deck 65 ft awl,top deck 120 x 161 ft with slots for 36 wells. Two drilling rigs, one on west side and one on east side. Completely self-contained with two levels, rig floor 95 ft awl.

December 1, 1970, 09:30 CST, Gulf of Mexico, Block 26, South Timbalier Area.

Weather - high scattered clouds, visibility 10 mi, wind S at 4 kts, seas calm.

Primary means of escape: 10 fixed stairways from rig floor to perimeter of BOP deck, 3 fixed stairways from BOP deck to wellhead deck, 2 fixed stairways from wellhead deck to boat landings @ waterline.

Secondary means of escape: 6 knotted manila ropes spaced around perimeter of BOP deck, extending to waterline.

LS devices on board platform: 7 lifefloats (4 15-man, 1 18-man, 1 12-man, 1 6-man) 2 on S side of rig deck, 2 on N side of BOP deck, 2 on W side of wellhead deck, 1 on E side of wellhead deck.

7 Ring life buoys: 40 ft apart, perimeter of rig and BOP decks at least 80 life preservers (U.S. Coast Guard approved): 1 next to each bunk in living quarters, various places on platform (3 boxes next to lifefloats on wellhead deck), 6 work vests on each rig floor and pipe rock area.

Fire fighting equipment: in compliance with 33 CFR 145 (fire extinguisher checked weekly). 61 men employed on platform at time of casualty: 2 aboard M/V van tide moored @ SE corner, 27 in the quarters, 14 on rig floors, 10 on other parts of platform, 8 at unknown locations.

At approximately 0945, one worker saw the lubricator blow off Well B-21, and gas spray out of the well and strike the bottom of the rig floor. Although a few men reported hearing an air leak, the first real indication that something was wrong was a muffled explosion. When the first explosion was heard, another worker sounded the general alarm and pulled the lever at one of the remote stations to shut in the production wells. One worker called for help over the radio, sounded the general alarm, and also shut in the production wells. Others also shut in the wells and sounded the general alarm.

Oil spraying out between the rig floor and the mud pump room formed an oil mist which created a screen across the rig floor. Approximately 2-3 minutes after the blow out, the oil mist ignited. Within minutes almost the whole platform was engulfed in smoke and the BOP deck was in flames. Before the mist ignited, at least 4 men were able to go down the stairways to the M/V Van Tide. After ignition, flames prevented men from using the stairways and forced them to use the manropes or to jump.

Additional explosion followed: one of the first engulfed the still-moored Van Tide in flames.

Most of the men exited the platform from behind the quarters. Confusion and congestion around the two manropes: men shoved off the manropes; other men falling and hitting those already on the ropes, knocking them off. Only 9 actually used the ropes, and none made it all the way down, but were forced to let go at various heights because of explosions and fire or because of rope burns to their hands.

39 abandoned platform by jumping

9 used manropes to some extent, then dropped

1 was blown off platform

5 walked down stairways

5 abandoned by unreported means

2 were aboard the Van Tide.

All men had abandoned the platform in less than 10 minutes. 53 of the 59 men abandoning were wearing life preservers when they abandoned. 4 persons died and 15 were seriously injured. All the survivors or bodies (except one) were rescued or recovered from the water in less than one hour--the majority were rescued within 30 minutes. One body was not recovered until December 8th. The M/V Van Tide and M/V Adam David (standby boat @ Platform A) rescued most of the men in the water. Oil company helicopters landed on the water and picked up survivors. Coast Guard notified @ 0955 by M/V Coastal Cruiser which had heard radio call for help.

Of the deceased, one died of burns, 3 of drowning, one without life preserver (explosion had blown his life preserver and some of his clothing off his person before he jumped into the water--he swam toward

the Van Tide, not recovered until December 8), two with life preservers (force of impact with water after fall of 70 ft knocked them unconscious and pushed preservers high on their necks, allowing them to float face down).

Most injuries resulted from jumping into water from excessive heights rather than from fire itself. Also adequacy of knotted manropes as escape means is questioned.

Donned life preservers sometimes tore loose, burst, or otherwise were damaged in the impact with the water.

Survivors comments concerning improved means of escape:

(1) Use some sort of chute

(2) Use form of fireman's pole

(3) Build shield near manropes

(4) Build wall around wellhead area

(5) Install sprinkler system around wellhead area

(6) Enclose stairways with fire retardant material

(7) Separate quarters on another platform with catwalk to drill platform

(8) String cable from platform to water, at angle, with individuals trolleys for escape.

Shell Oil researching new means of rapid escape: fireman poles and large chute most promising.

32669 J. STORM II, drilling barge, 4,980 gross tons, 210 ft. lg, built 1971, not powered, radio, uninspected.

December 3, 1972 @ 10 p.m. CST (night) in Gulf of Mexico, South Pass Block 78.

Weather partly cloudy, visibility 10 miles, wind 8-10 knots, 70° air, water calm 1-2 ft, fog reported by C.G.

Drilling rig with twenty-nine POB encountered gas flow that broke out around conductor pipe and a fire started on the surface.

A crew boat took twenty-five men off the rig and four were taken by helicopter - rig sank - no details on how men got off.

31871 ROBERT H. McLEMORE, jack-up work barge, diesel, 118 gross tons, 55.7' lg, 1970, equipped with radio and radar, uninspected.

August 12, 1972, 1300 CDT, block 113, ship Shoal Area, Gulf of Mexico.

Weather clear, wind 3 knots, 95° air, sea calm, 70° water, 1 ft sea.

Barge was jacked up and stationary, a gas line was broken and caught fire, fire lasted about 20 minutes. Seven POB jumped off platform all wearing life preservers, four swam to an adjacent platform, three picked up by a work boat in the area. No details on how the fire was extinguished - apparently no other assistance was provided so fire must have burned out - significant damage but vessel not completely lost.

11262 TOPPER II, drilling barge, unpropelled, 2159.44 gross tons, 158.5 ft, steel, 1968, uninspected, master unlicensed.

September 11, 1970, 13:45 CDST, Gulf of Mexico.

Weather - clear, visibility 5 mi, wind SE at 5 kts, air 80 F, sea 1-2 ft SE.

Topper II is a jack-up mobile drilling barge equipped with cantilever capable of extending out 40 ft from edge of barge. Barge was adjacent to Chevron Oil Company Platform Block 63-A, cantilevered out 37 ft, drilling. Explosion on adjacent platform resulted in fire directly opposite starboard portion of Topper II. Abandon platform signal was sounded, ceased moments later due to effects of fire, but passed by word of mouth. Twenty-five personnel aboard platform and barge proceeded to lower catwalk and abandoned platform. One 15, and one 20-man C.G. approved inflatable life rafts and three other 15-man life rafts and life rings were used. Personnel picked up from water by work vessel that was in area at time. Fire diminished itself after a short time. Personnel reboarded platform at about 15:00 to extinguish few small fires. Eight dry chemical, and six foam-type portable extinguishers used.

Miscellaneous

22294 R/V SEARCHER, diesel, 107.4 tons, 80.6 ft, 1963

May 3, 1972, 14:30, 30 miles off Cape Blanco Bearing, 30° Mag, 85°W, 9° N, Pacific Ocean.

Weather - clear, visibility 40 miles, wind SW at 3 kts, Air 84 F, calm seas, water 84 F, 2 ft W, swell 2 ft SW.

While underway fire broke out in engine room stopping all power. CO_2 discharged into engine room but due to heat and smoke unable to get close enough to do any good. Radio signals could not be sent due to lack of power. Twelve POB abandoned ship in Elliot life raft and life jackets. Ship burned and sank. Passengers picked up by B/M Tuluca and carried to shore.

10702 CAPTAIN O.I.C., JR., crew boat, diesel, 13 gross tons, 33 ft, steel, 1955, draft 3 ft fwd, 5 ft aft, uninspected, operator not licensed.

September 14, 1970, 10:00, Bayou Terrebonne, Louisiana

Weather - partly cloudy, visibility 5 miles, wind SE at 5 kts, temperature unknown, sea calm.

Vessel was underway to Montegut for engine repair. Operator noticed smoke coming from engine compartment hatches. Slowed boat, opened engine compartment hatches and entire compartment burst into flame. Beached vessel on bayou bank. Attempt was made to get fire extinguisher, but in vain. One POB jumped off boat. Engines running and jammed because of intense heat. Vessel total loss. A seaplane landed and picked up the operator (only person on board) and flew him to Boudreaux Canal. No life-saving equipment used.

30681 COONEYS VACATION, flat-deck barge, 270 gross tons, 126 ft long, uninspected, derrick barge.

2:00 a.m. Atachafalaya River at the west bank near Kratz Springs.

Two persons were sleeping aboard the barge and awakened to find it on fire. They left the barge and as they were leaving, heard an explosion. The barge was tied up at the dock. The barge sank. One man was burned on his hands.

11062 D'BOTE, pleasure, diesel, 41 gross tons, 55'5", wood, 1961, draft 4 ft fwd and aft.

December 29, 1970, 15:30, Galveston Bay (Light #35, Houston Ship Channel).

Weather - clear, visibility 5-6 miles, wind SE at 4-8 kts, gusty, air 30 F, sea light chop, 1-2 ft, SE, swell unknown.

Fire broke out in engine room and the operator stopped the boat and pulled the manual lever to CO_2 fire-protection system. The system probably did not work as it had no apparent effect. Operator went below with small chemical fire extinguisher but was forced back by smoke. Used smoke flares to try to signal for help. He was forced off boat by heat and used life raft and wore life jacket. Fisherman in small boat pulled operator out of water and transferred to C.G. vessel. C.G. had been notified by radio by nearby tug. Boat burned to waterline and sank.

A1.3 Vessel Fire

Passenger vessels (100 gross tons or more)

31427 DELTA QUEEN, passenger, steam, 1650 gross tons, 250 ft length, 1926, radio, radar, inspected.

January 7, 1973, 11:30 EST (day), Cincinnati, Ohio, Ohio River

Weather - clear, windy, no temperature information.

Vessel was docked for repairs. Smoke coming from cabin area, (near stack). There were 10 POB. Two dry-chemical extinguishers, four soda-ash fire extinguishers and fire hose used to put out fire. Sprinkler system did not activate. The temperature did not rise enough. Cincinnati Fire Department arrived in less than 10 minutes after being called. Fire Department was called approximately 5 minutes after fire was discovered.

Passenger vessels (less than 100 gros tons)

32849 GOLDEN GATE, passenger vessel, 98 gross ton, 115 ft lg, built in 1969, equipped with radar and radio.

May 15, 1973, 0800 local time, 3/4 mile E of Alcatraz, in San Francisco Bay.

Weather - clear - visibility 8 miles, wind 10 kts, air temp. 52°, sea calm.

There were 7 crewmen and 6 passenger aboard the vessel. A flexible rubber hose in the oil-supply system ruptured and lubrication oil sprayed onto a turbo charger, which ignited the oil and injured one crewmember. A CO_2 fire extinguisher system in the engine room was activated as a result of the fire. The C.G. was contacted and responded with three C.G. cutters and a hover craft. No other life-saving equipment was used.

30246 RICK SUE, passenger (charter) vessel, 20 gross tons, 37 ft lg, built 1969, eqpd with radio, INSPECTED.

June 26, 1972, 1:00 pm, in Gray's Harbor, Pacific Ocean, off the coast of Washington.

Weather clear, visibility good, win 5 to 10 knots, 60° air, sea flat.

Freight vessels

31277 S/S TOPA, freight vessel, steam, built 1945, 6065 gross tons, 459 ft lg, equipped with radar and radio, inspected.

Fire on January 12, 1973, Orange Street Warf, New Orleans, on the Mississippi River.

Weater - clear, visibility 10 miles, wind 5 kts, air temp. 35°, no data on the sea conditions.

The Topa had 38 crewmen aboard and 40 longshoremen. The cause of the fire was the vessel's cargo of bulk corn came into contact with an uninsulated steam line which set the corn on fire. There were no crewmen endangered by the fire. The fire was extinguished by the fireboat, Deluge, operated by the New Orleans Fire Department. There is no indication of any use of other life-saving equipment.

31328 PRESIDENT HARDING, freighter vessel, steam powered, 7,962 gross tons, 492 ft lg., equipped with radar and radio.

December 10, 1972, at 1445 local time, alongside the Ballard Pier in Bombay, India.

Weather - clear, visibility 15 mi, wind 5 kts, air temperature 84°, sea smooth.

There were 47 crewmembers aboard the vessel. Fire broke out in #5 hold and the fire was extinguished using a steam-smoothering system. There were no personnel casualties. The casualty report indicates that an oxygen-breathing system apparatus was used during the ship casualty.

12097 DEL SUD, freighter, steam, 8,638 gross tons, steel, 1947, inspection certificate 6-16-70, master licensed by C.G.

May 14, 1971, 05:10, Mississippi River, moored at the Bienville Street whart.

Weather - partly cloudy, visibility 12 mi, wind NE at 8 mph, 60 F, sea conditions not available.

There were 10 crew and 60 stevadores aboard at the time a fire occurred on the deck forward of Number 1 hatch. A hatch-tendon mooring line burned, apparently caused by stevadores placing a hatch tent over a lighted portable cargo-extension light. At 05:10 the fire was reported, a general alarm sounded and the engine room notified. Hoses were stretched and the fire was extinguished by the second officer assisted by stevadores that were working at Number 3 hatch. Firemen from ashore and the fireboat, Deluge, boarded the vessel and assisted in clearing the area of all flame and the sparks. At 05:45 the fire was completely extinguished. There were no injuries in this casualty. No life-saving equipment was used, no persons were in the water.

11514 S.S. CONTAINER FORWARDER, container vessel, steam, 15,461 gross tons, 564.9 ft, steel, 1946, inspected, certificate December 22, 1970, master licensed by U.S. C.G., draft 23 ft fwd, 27 ft aft.

January 14, 1971, 05:25, Atlantic International

Weather - snow flurries, visibility 5 mi, wind NW at 7-8 kts, gusty, 34 F, sea rough with moderate NW heavy swell 15 ft NW.

While underway, vessel rolled moderately to heavily. Series of violent rolls caused container lashings to carry away with collapse of one container at Bay #10. This container spilled cargo onto deck, caused short circuit [contents of collapsed containers come into contact with electric cables used to supply Reefer container with power-cabler had pulled loose and shorted] and consequent fire.

Fire alarm was sounded. The fire was brought under control and extinguished, using two 2-1/2 inch fire hoses and water.

31074 CHERAMIE BO, Truck #15, freight, diesel powered, 183 gross tons, 144 ft, 1966, radar and radio, uninspected.

September 7, 1972 at 5:35 p.m. at Block 129, Eugue Island, Gulf of Mexico.

Weather - clear, 5 kt wind, sea calm, approximately 1 ft.

The vessel was used as a supply vessel for offshore oil rigs. At about 5:35 p.m. a fire was discovered in the engine room. The 5 persons on board shut down the engines and after about 30 minutes were successful in extinguishing the fire. One man was overcome by smoke -- picked up by helicopter -- and taken off for treatment.

11599 SEATRAIN CAROLINA, freighter, steam, 7911 gross tons, 559 ft lg, 1944, inspected, certificate dated 1-22-69, reissued 4-8-70, master licensed, draft 17'7" fwd, 27'7" aft.

January 24, 1971, 19:30, San Diego Bay.

Weather and sea not applicable.

While vessel was being tied to dock, 450 volt circuit breaker shorted, causing fire in switch board panel. Fire was extinguished at over W/3 portable 15 lb CO_2 extinguisher.

Believed short caused by salt buildup on circuit breaker.

11434 SANTA LUCIA, freighter, steam, 9313.67 gross tons, 560 ft, steel, 1966, certificate, inspection May 1, 1970, master licensed.

January 24, 1971, 11:23, Atlantic Ocean International (21°34'N, 69°07'W)

Weather - partly cloudy, visibility 15 miles, wind ESE at 19-23 kts, 83 F, sea calm, 71 F, 1-3 ft, SE, swell nil.

Fire reported in #3 hold at 11:23. Shortly thereafter smoke detector alarm sounded. General alarm sounded at 11:24 and emergency squad mustered to scene. Tried to extinguish with fire hoses. The dense smoke made that method impossible. Hatch was covered, ventilation stopped, and CO_2 applied to #3 hold. Water from fire hoses played over the hatch and the walls of the #3 hold. Fire completely extinguished by 20:00. Apparent cause was spark from hot repairs to hatch covers. There were 42 crew and 8 passengers aboard.

20071 EXPORT CHAMPION, steam, 11,000 gtoss tons, 493 ft, 1963, inspected.

June 16, 1971, 18:45, Pier 6, north Inner Berth Bush Terminal, Brooklyn, New York Harbor.

Weather - partly cloudy.

Fire started in hold due to faulty lights. Fire was brought under control by N.Y. Fire Department and CO_2 cylinders aboard the ship.

22423 M/V ST. JOAN OF ARC, (British), diesel, 45.5 tons, 61 ft, freight.

March 18, 1972, 10:30 a.m., Bulk-Head, Cha., St. Thomas, V.I.

Weather - clear, 2 mi visibility, wind SE at 10 kts, smooth seas, waves 2 ft SE

While in St. Thomas Bay, fire started in engine room of vessel. There were three POB. Fire was fought with chemical fire extinguishers. Most of super-structure burned, no information on abandon ship procedures.

22279 SHIRLEY LYKES, steam, 9244.11 gross tons, 494'8" long, 1962, inspected.

January 31, 1972, 18:35, Lat. $2^{o}32'$S Long. $33^{o}30'$W, South Atlantic.

Weather - partly cloudy, visibility 12 miles, wind ESE 7-10 kts, 80^{o}F, waves ESE, 2-3 ft water 81^{o}, swells ESE, 6 ft.

Carrying a mixed cargo of fuel oil and chemicals, an explosion and fire occurred. Five fire hoses and a fire pump were used to extinguish the fire.

30286 PAUL TIETJEN, freight, steam, 1907, 7,038 gross tons, 532 ft long, radio and radar, inspected.

July 24, 1972, 1:30 EST, St. Clair River.

Weather - clear, visibility 15 mi, wind 12 kts.

Fire started in the galley. Three 50-lb CO_2 fire extinguishers and one dry-chemical extinguisher were used mainly on the grease, and water was used on the wood. The fire was successfully extinguished. No other life-saving equipment was reported used.

11174 GOLDEN NOON, freighter, steam, 7380.57 gross tons, 455 ft, steel, 1945, certificate inspected November 4, 1968, renewed June 17, 1970. Master licensed, draft 12 ft 10 in fwd, 22 ft 6 in aft.

December 12, 1970, 02:00, Pacific Ocean International.

Weather - partly cloudy, visibility 20 miles, wind NNE at 20 kts, 81 F, sea moderate, 84 F sea, 4 ft NE, swells 8 ft NE.

While underway, experienced problems with boiler, both starboard and port out. When lighting port boiler, using diesel oil to start, fire broke out in boiler. Time of fire 09:50. Fire alarm sounded, crew alerted, and portholes and watertight doors secured. Used 3/4-inch hose to fight fire with 2 additional 3/4-inch hoses rigged. Used portable CO_2 extinguisher in engine room and ten hand CO_2 extinguishers, constantly hosing down boiler to contain fire and extinguish flames. Urgent message was sent requesting assistance at 10:21. No actual assistance rendered, but other vessels standing by and U.S.N.S. Pendleton and SS Pecos proceeding to assist.

Pecos nearest vessel with ETA, 13:30, December 12. Dismissed Pendleton 13:41. At 15:40 bilge pump and fire pump in operation as starboard boiler brought into operation. At 16:58 released Pecos, assistance not needed as fire in port boiler dying down. Continued fire watch and hosing down. At 18:10 slow ahead. At 18:57 full ahead, steaming on one (starboard) boiler for Honolulu.

11122 VALMA LYKES, freighter, steam, 8180 gross tons, 459.1 ft, steel, 1945, inspection certificate 11-7-69, master licensed, draft 18 ft fwd and aft.

September 6, 1970, 19:35, Indian Ocean (25 miles from P. Buoy entrance, Beira, P.E.A.)

Weather - clear, 12 mi visibility, wind SE at 3 kts, 79 F, slight sea, 78 F, 1 ft, SE, no swell.

Vessel's Rich-Audio fire-detecting system indicated fire in #2 hold. Personnel with O_2 breathing apparatus entered hold but couldn't pinpoint source/location of fire. Vessel, with permission, entered Beira Harbor and moored at 01:00. On September 7, at approximately 02:47 flooded #2 port after deep tank with 500-lb CO_2. Fire Department

stood by, but not used. Temperature at 09:30 in deep tanks - 78° fwd, 80° aft. At 13:15, normal readings except for 94° in aft deep tank. At 23:10, on September 9, discharged hold and found source of fire to be broken containers of salad oil stowed on three tiers of plywood flooring which was laid over and separating paper bags of diatomoceous earth cargo. At 21:30, September 10, all damaged cargo removed and cargo reloading completed.

12054 DEL SUD, freighter, steam, 8,638 gross, 495 ft, steel, 1947, certificate of inspection 6-16-70, master licensed.

April 27, 1971, 12:45 CDT, Mississippi River, moored at New Orleans.

Weather - clear, winds SW at 7 kts, 78 F, sea water 66 F, no other data on sea or weather conditions.

A fire started in the galley area on the galley range and spread through ducting to the fan room on the shelter deck adjacent to state room Number 30. At the time of the casualty there were 60 POB, (40 crewmen and 20 shore repairmen). The fire was extinguished by two fire boats, C.G. and New Orleans Fire Department. Fire extinguishers from the vessel also were used in controlling the fire. There was fire damage to the galley and equipment, smoke damage over the entire area and water damage to the shelter deck and second deck. There were no injuries in this casualty and no persons went into the water. There is no information on the length of time the fire was in progress, or specific equipment used to extinguish it.

12196 ST. ANDREW M, freighter, diesel, 91 gross, 75 ft, wood, 1961, certificate of inspection not available, master not licensed. British vessel.

May, 25, 1971, San Juan Harbor, Puerto Rico.

Weather - partly cloudy, visibility 5 mi, winds NE 5-8 kts, temperature unknown, sea calm.

The cook was starting the stove. When he opened the valve and introduced a match, the stove exploded. It was using lp gas. The C.G. and San Juan Fire Department assisted in extinguishing the fire. The entire deckhouse burned. There is no information as to fire extinguishing equipment used or any possible injuries. The vessel was

not a total loss. There were seven crew members aboard.

11619 OLGA JACOB, freighter, diesel, 6659.29 gross tons, 458.1 ft, steel, 1970, German vessel, draft unknown.

February 16, 1971, 20:35, Canaveral Harbor, Florida.

Weather and sea not applicable.

While vessel was berthed, smoke was discovered issuing from lower section of Hold No. 5, which contained cargo of liner board and pump wood, covered by plastic and plywood, rocket launching equipment for German Air Force stowed atop that. Loading had been completed approximately 2030, and smoke detected approximately 2035. Density of smoke prevented getting to source of fire with hand fire extinguisher. Fifty-five bottles of CO_2 were emptied into the hold, and weather deck hatches were closed, and ventilators were hooded. Fire fighting continued through february 17, 1971. Discharge of cargo from hold No. 5 began at 15:00 on that day. Assistance rendered by U.C. C.G., Port Canaveral, USAF Patrick, AFB,Cape Canaveral Fire Department, and Cocoa Beach Fire Department. . At time of casualty, 28 crew members and 1 passenger was aboard. Cigarette discarded by stevedore was probable cause of fire.

11993 JEAN LIKES, freighter, steam, 9,239.88 gross tons, 495 ft, steel, 1961, inspection certificate 9-23-69. Master licensed by C.G.

March 24, 1971, 16:15, North Atlantic Ocean International

Weather - partly cloudy, 25 mi visibility, wind NE at 7-10 kts, temperature 65 F, sea water 62 F, 3 ft NE, swells 3 ft NE.

At 16:15 the chief cook reported a fire in the galley. The general alarm was sounded and officers and crew reported at the scene of the fire. The crew was instructed not to use water until the source of fire was determined and CO_2 extinguishers were brought to the scene. Vent system to galley and adjacent areas were shut off. At approximately 16:25 the source of fire was discovered to be the neoprene lining of the garbage chute located in the garbage room. Fire hoses were brought to bear and at 16:45 chief engineer advised that the fire was under control. At 16:54 the garbage room and adjacent areas were inspected and it was determined that the fire was extinguished. At 16:56 the crw was secured and vessel resumed full-speed ahead.

There were no injuries in this casualty. Two portable CO_2 extinguishers were used as well as the water and fire hoses. There were 47 crewmen and 11 passengers aboard at the time of the casualty.

Tanker

30714 CHESTER A. POLING, tankship, 1546 gross tons, inspected, 281 ft long, 40 ft wide, 1033 net tons, built 1934, diesel, radio and radar.

May 20, 1972, 12:10 EDT, vessel underway into Narragansett Bay, south of Newport Bridge, Atlantic Ocean.

Weather - winds 35 mph and gusty, 64 F air, 45 F water, visibility 3 miles, heavy rain sea choppy.

Vessel was underway with 7 POB when it sufferered an explosion and fire in the cargo pump engine room. The CO_2 system operated and the general alarm was sounded. Crew members found the fire with portable CO_2 and foam fire extinguishers. The fire was extinguished at about 12:15 (about 5 minutes). The C.G. was notified. There were no injuries. C.G. was notified. No use of life-saving equipment.

31186 EASTERN SUN, tanker, 18,800 gross tons, 618 ft lg, 1955, inspected, radio and radar, steam powered.

August 25, 1972 at 18:40 EDST, at #2 Dock of Sun Oil Company at Marcus Hood, Pennsylvania.

During loading of the ship, gasoline leaked from a 14" pipe line and gutted into bilge end up to the lower section of the engine room. At about 18:35, the gasoline in the pump room flooded to approximately 9', and at this time it was found, and subsequent pumping of fuel was discontinued. At approximately 18:40 an explosion occurred. No crew members were in immediate area of explosion, and a cardox system was activated and this succeeded in extinguishing the fire in a few minutes. There were no crew men injured in the fire, and there was no use made of life-saving equipment.

31576 BRADFORD ISLAND, tankship, 18,941 gross tons, 14,957 net, 598 ft, 84 beam, 47 depth, 1945, radio, radar, inspected.

December 11, 1972, 20:00, Triangle Dock, Jacksonville Port of Authority, St. Johns River, Florida.

Weather - clear, visibility 10 mi, wind 3 kts, 75 F air, sea calm.

At 19:45 while discharging gasoline and kerosine, an explosion and fire occurred in after pump room. One person injured during explosion. No one went into water. Pump room was secured and CO_2 extinguisher applied in about 2 min. C.G. and Fire Department was called. Fire extinguished. Pump room remained closed overnight.

32763 NORWEGAN TANKER, 580 ft, radar and radio.

November 28, 1972, 23:24 CST on Lake Michigan, 15 mi S of Manitou Island.

Weather - visibility 15 mi, partly cloudy, wind 25 kts, gusty, 32 F air, 5 ft sea.

There were 44 crew men aboard. There was an electrical fire on board. Four crew men suffered burns on passing through a passage-way where paint and wiring was burning. Men were asleep when fire started.

22231, SPIRIT OF LIBERTY, tanker, steam, 20,948 gross tons, 660.0 long, 1968, inspected.

May 22, 1972, 07:21, 1.3 miles SE of China Beach Submarine Line Moorings, Danang, S. Vietnam, South China Sea.

Weather - partly cloudy, 15 mile visibility, wind calm, 82 F, water calm at 80 F.

While maneuvering, main switch board caught fire. Three 15-lb CO_2 fire extinguishers were used to put out the fire.

12252 TEXACO KANSAS, tanker, steam, 14,152 gross tons, 549 ft long, steel, 1943, certificate of inspection February 3, 1971, master licensed.

June 2, 1971, 02:25, Sabine ship channel, Texas.

The vessel had just arrived at the Sabine bar and the pilot had just boarded. After the engine had been placed on full-speed ahead, the engine room notified the bridge that the engine was out of commission and there was an electrical fire in the main motor. The crew extinguished the fire using CO_2 and dry chemical fire extinguishers. There was a total of 44 POB.

11731 TEXAN, tanker, steam, 13,274 gross tons, 633 ft long, steel, 1945, inspection certificate June 8, 1970, master licensed.

March 31, 1971, 23:00, Gulf of Mexico, International.

Weather - clear, visibility 15 mi, winds SE at 5 kts, 70 F, sea moderate to rough, 72 F, 3-5 ft SE, swells 3-5 ft SE.

At approximately 23:00 the master was informed of a fire in the galley. This fire was contained satisfactorily by the range exhaust duct fire damper. The crew successfully combatted the fire with CO_2 extinguishers and water and at 00:24 the fire was extinguished. There were no injuries in this casualty.

Barge

30557 B & R TANK BARGE #60-3. 72 gross tons, 60 ft, 1951, normally not manned.

August 2, 1972, 09:00, Nome Harbor, Snake River, Nome, Alaska.

Weather - clear, visibility 15 mi, wind 5 kts.

The tank barge was moored at the dock and in the process of being pumped out prior to reloading the vessel. Two crewmen were operating the pumps. Fuel fumes were ignited by the open motor on the pump. There was an explosion and brief fire in one tank. The 2 POB proceeded to put out the fire using hand fire extinguishers. They also moved a towing vessel away from the barge. After using two CO_2 fire extinguishers the fire was nearly out. Corps of Engineers personnel and the Nome Fire Department arrived to finish extinguishing the fire. There was no life-saving equipment used.

Fishing vessel (over 50 gross)

30463 SEA HAWK, fishing vessel, 86 gross tons, 94 ft, 1953, radio, uninspected.

September 1, 1972, 9:00 p.m. EDT, 45 miles East of Chesapeake Light Tower in the Atlantic.

Weather - rain, visibility about 2 miles, 30-35 kt winds, air 65 F, sea rough.

Fire in engine room, the cause was believed to be the electrical system. The vessel's fixed CO_2 system was used to smother the fire. Reflashes occurred on wood structure when hatches were opened. There were 9 aboard, but apparently none abandoned. No one injured. Another vessel called C.G. The fire was suspected to have disabled the radio.

NAUTILUS, fishing vessel, diesel, 838.18 gross tons, 172.9 ft long, steel, 1944, uninspected, master licensed. Draft 14 ft fwd, 15 ft aft.

January 19, 1971, 14:35 Pacific Ocean International, off San Lucas, Mexico.

Weather, partly cloudy, visibility clear, wind NE at 3 kts, 78 F, Sea choppy, 80 F, 4-5 ft NE, swells of 6-7 ft NE.

While fishing, fuel-oil centrifuge overflowed. Fuel oil ran across deck in engine room, dripped onto exhaust, and ignited in flash fire. Damage to wiring, gauges, auxiliary engine, 2 small motors,and fuel oil separator. Fire extinguished using three, 15-lb CO_2 portable extinguishers.

Fishing vessel (under 50 gross)

30242 ROSET, fishing vessel, 11 gross tons, 30 ft lg, radio, 1958, inspected.

July 19, 1972, 9:30 p.m., 1 mi S of Foggy Point Alaska, near Ketchikan.

Weather - clear, visibility unlimited wind 2 kts, sea calm.

There were 2 POB. A fire started in the ignition system and the vessel and engine were incapacitated. Another fishing vessel called C.G. for assistance. The vessel was towed into port. Fire was extinguished by means of a fire extinguisher. (no details as to type). One person slightly injured.

10225 CHIEF, tugboat, diesel, 40 gross tons, 47 ft, steel, 1953, uninspected, Master not licensed.

August 23, 1970, 06:00, Atchafalaya River, Morgan City, Louisiana.

Weather - clear, visibility 10 miles, wind calm 75 F, sea calm.

It was noticed that smoke was coming out of the engine room as vessel was "idle-speed ahead" to hold its tow into the bank. The fire was extinguished at 07:25 by the vessel's crew. The engine room was extensively burned. Assistance was rendered by the crew boat of the California Oil Company with fire extinguishers and water hoses and by the crew boat of the Texaco Oil Company with one CO_2 fire extinguisher. The C.G. Point Lookout arrived at 07:30. Two crewmen were aboard the vessel at the time of the casualty. There were no injuries--no life-saving equipment used. No one went into the water.

10204 CLAIRE MORAN, motor tug, diesel, 249 gross tons, 107 ft long, steel, 1940, uninspected, Master licensed.

July 29, 1970, 17:30 hrs, Caribbean Sea, Phillips Petroleum Company Terminal, Las Mareas, Puerto Rico.

Weather - clear, no other information on sea or weather available.

While a relief boat was preparing the 18:00 meal for the crew, the oil-burning unit in the galley range caught fire, because of defective carburetor in the galley stove which allowed the burner to flood. The burner flared up and ignited seat cushions and lockers in the galley. The cook used the galley extinguisher, but failed to shut off the fuel supply. The stove caused the fire to flare up again, this time spraying the galley with burning fuel. Additional fire extinguishers were used as well as the fire hose of the tug, Christine Moran, which was nearby and the blaze was extinguished. There were four POB. There were no injuries, no use of life-saving equipment, no personnel went into the water.

11436 STEVEN MCALLISTER, tug, diesel, 194 gross, 94 ft, steel, 1949, certification inspection not available, person in charge licensed, draft 11 ft fwd, 13 ft aft.

January 21, 1971, 13:30, North River, New York.

While backing out of slip, fire broke out in engine room. Crew could not get to fire because of smoke. Called for assistance. Fireboat Harvey responded as well as tugs Dalgelleagle and Grace. Fire extinguished at 14:50. Crew of 7 POB. Tug did not have fixed CO_2 fire-extinguishing system.

11192 NEPTUNIA, tug (deep sea), diesel, 499 gross tons, 159 ft, steel, British vessel, draft 12 ft fwd, 15 ft aft.

January 14, 1971, 05:00 EST, Hudson River, moored at Berth 6, Bethlehem shipyard.

Weather - snow, visibility 5 mi, variable wind at 5 kts, sea calm.

Seaman awoke to have a cigarette. The head of a match flew off into open box of matches and set curtains on fire. The seaman awakened another and told him to get extinquisher, and then left to warn others. A foam extinguisher wouldn't work and fire was out of control. At 05:13 the First mate awakened and informed master. Second mate called Fire Department. At 05:30 the Hoboken Fire Department proceeded to put out fire. At 15:30 the fire was out, and vessel was pumped out. Body found in crew quarters. Although person was warned of fire, he did not get out, fell back asleep after warning.

11035 CITY OF JOLIET, river towboat, diesel, 440 gross tons, 120 ft, steel, 1951, uninspected, master not licensed by C.G.

November 8, 1970, 21:00 CDT, Upper Mississippi River.

Weather - clear, visibility fair, wind and sea conditions not available.

A cracked oil line resulted in a spraying of oil lube onto the heated surface of the main engine exhaust. This caused a fire in

the engine room at the port main engine. The fire was confined to the engine room and was extinguished by the crew. No information is available on the fire-extinguishing equipment used or how long it took to extinguish the fire. There were 10 crew members aboard at the time of the casualty. There were no injuries.

11788 ANN BRENT, Towing vessel, diesel, 341.58 gross tons, 103.6 ft, steel, 1960, certificate of inspection not available, master licensed.

February 16, 1971, 11:40 CST, Lower Mississippi River.

Weather - clear, other information on weather and sea not available.

A fractured cylinder wall on the Number 7 cylinder of the right back of the starboard engine caused heat build up and crank-case explosion. The explosion sprayed hot fuel into the engine room. The fuel ignited and in turn ignited the bilges. The fire englufed the engine room in a matter of seconds and spread throughout the forward half of the vessel before it was extinguished. The crew extinguished the fire by using the firepumps on the Ann Brent and the Ruth Brent, the latter passing nearby when the fire started. The Ann Brent had a 300-lb dry chemical extinguisher located on the second deck but it had not been thoroughly cleaned after its last test three weeks before and proved hard to activate. The extinguisher's 100-ft hose was uncoiled and draped over the second deck railing to fight the fire but by the time the extinguisher was activated, the flames from the fire had burned through the hose. There were no injuries and the crew did not abandon the vessel.

11024 NATIONAL TRADER, tow boat, diesel 128 gross tons, 76 ft long, steel, 1964, uninspected, master not licensed.

November 27, 1970, 20:30 CST, Lower Mississippi River.

Weather - partly cloudy, visibility 7-9 miles wind, NE 2-3 kts, temperature unknown, sea conditions unknown.

Fire broke out on the aft of the lower engine room. This was combatted with fire extinguishers on board and by the C.G. which had three vessels assisting. The vessel was not a total loss. Specific fire-fighting equipment is unknown. The only injury was sustained by

a crew member who fell down a ladder while carrying a portable fire extinguisher.

21923 GNOTS VII, diesel, 235 gross tons, 85 ft long, 1971, uninspected.

May 5, 1972, 08:30, mile 128 AHP Mississippi River.

Weather - clear, good visibility, variable wind.

Lubricating oil line ruptured on hot engine causing fire and damage to engine and wiring in engine room before brought under control.

20090 GOBBLER, tug, diesel, 284 gross tons, 82.3 ft long, 1969, uninspected.

July 4, 1971, 11:40 a.m., McDuffie Island, Mobile River, Alabama.

Weather - partly cloudy, 8 mile visibility, wind, N at 3 kts, calm seas.

Lube on line broke while underway and fire resulted in engine room. Fire was put out by CO_2 extinguishers, Mobile Fire Department and U.S. C.G.

Platform - drilling vessel

12437 STORMDRILL I, drill barge, 1737 gross tons, 142-1/2 ft, steel, 1964, certified unknown, draft unknown.

May 5, 1970, 17:40, Gulf of Mexico, Block 27, South Pass.

Weather - clear, visibility 8 mi, wind SSW, sea 3-5 ft.

Gas accumulated in the pump room and exploded. Life rafts were launched but not used. None of 27 crew abandoned. Three men were injured. No information on call for assistance, but helicopter and boat rendered assistance, probably to remove injured.

Miscellaneous

22293 FRANCIS ANN, salvage, diesel, 174 tons, 96.6 ft lg, 1943, uninspected.

February 14, 1972, 1:00 to 1:30 a.m. Los Angeles Harbor, Berth 195.

Weather - clear, not influential to casualty.

While tied up, a fire started in the galley, One POB was sleeping and drunk. He died of asphyxiation. The fire was put out by the L.A. Fire Deoartment. None of the ship's fire fighting equipment was used.

31203 CALTIDE, motor vessel, uninspected, oil exploration vessel, diesel, built in 1963, 297 tons, 160 ft lg. equipped with radio and radar.

October 4, 1972, at 0205 PST, at the Dock #1 Port Heuneme, California.

Weather - clear, visibility 5 miles, sea calm, vessel was at the dock.

There were five crewmembers aboard and at approximately 0205, the Captain noticed smoke coming from the port engine room hatch. A few seconds later the ship's generator went out. He mustered the crew. Using fire extinguishers they were able to penetrate the smoke and heat and seal off the engine room. Also the fire department was called and fire department arrived on the scene at 0220. The fire was out at 0755. There were no crew casualties, and also there were no life-saving equipment used during this casualty.

A1.4 Man Overboard

Passenger vessels (100 gross tons or more)

15769 ALEXANDER HAMILTON, passenger vessel, 2367 gross, 1252 net, 338.6 x 77 x 13.6 ft, 6' freeboard, 1924 inspected - sight-seeing yacht in New York.

July 28, 1970, at 16:32 vessel docking at North Bear Mountain Pier, Hudson River.

Weather, winds 12 mph, visibility 5 miles, 84° air, 70° water, current 1.5 knots, water calm.

As vessel was docking a deck hand was attempting to carry a mooring line ashore at the forward end of the vessel. When the vessel was about 4 ft from the dock the deck hand jumped on the dock; however, his foot slipped on contact with the dock and he fell into the water. He resurfaced about 25 ft aft and then disappeared. Two other crew men entered the water in an attempt to save him. They were not successful. The victim was not wearing any floatation at the time of the casualty. The body was recovered on July 31.

26078 CITY OF GRETNA, passenger/ferry, 354 gross, 331 net, 130 ft lg, diesel, built 1945, rebuilt 1968, inspected.

January 11, 1972, at 2046 a passenger jumped overboard into the Mississippi River while the vessel was moored at the Jackson Street ferry dock, New Orleans, Louisiana.

Weather - partly cloudy, visibility good, water was choppy with 5 mph current, wind 10-20 mph mid 60's air.

After the vessel had docked and was being loaded for the next trip, a passenger was seen by a crewman to jump into the water. The ship's bell was sounded and a spotlight was used in an attempt to locate the person in the water. The operator saw the man in the water swimming about 400 ft downstream. The current was strong enough that in about 30 seconds the man in the water was out of sight of the vessel. The operator notified the river bridge authority who notified the C.G. The body was not recovered. It is suspected that the man overboard was a suicide attempt.

36402 MISS CIRCLE LINE, passenger vessel, 369 gross tons, 251 net tons, 140 ft long, 33 ft wide, 13 ft deep, diesel, 1964, inspected.

April 24, 1973, 17:46, Pier 11 on East River New York

Weather - clear, visibility unlimited, 60 F, wind 5 kts, seas calm.

While vessel was docking, crewman fell into water when ship was 3-4 ft from pier. He was attempting to jump to the pier. Life ring thrown, another crewman went into water to hold him up, rescue boat launched and recovery made. He was in water about ten minutes. His head struck pier, and he died on way to hospital. He was not wearing a life preserver.

Passenger vessel (under 100 gross tons)

25344 MANSION BELLE, passenger vessel, inspected, diesel, inspected, 1942 to 1958 conversion, 13 gross tons.

July 4, 1971, 22:15, entrance to Los Angeles Harbor, Main Channel.

Weather - clear, no wind, sea calm.

Passenger was traversing a restricted area of the vessel, slipped and fell into water. He was seen by passenger and crewman. He was not wearing a life preserver. Vessel made 180° turn. C.G. was called, search lights were used, and other vessels were on scene in about five minutes. Body was recovered on July 13, drowned.

35546 P/V SHOWBOAT II, passenger, USA, 87 gross tons, 83 ft lg, 26 ft beam, diesel, 1965, inspected.

August 14, 1972, 22:25, Delaware River, 50 yards from Pier at Port Richmond.

Weather - clear, water calm, wind light, visibility good, air temperature 78 F.

Passenger apparently attempted to swim to shore and drowned. He was not wearing a life jacket. Body was recovered by C.G. on August 17.

35661 THEE QUE NEE TUE, passenger vessel, 24 gross tons, 62 ft lg, 1970, inspected.

May 16, 1972, 03:30, Lake Tohopekaliga, Florida.

Weather - clear, visibility poor (dark) no wind, water calm, temperature unknown.

The vessel was returning from a sight seeing cruise. Passenger sat on rail, legs overhanging boat, and fell into water. He was not seen to fall. Vessel turned and searched with lights. Could not find victim. A small outboard boat was launched to search. Body recovered May 17, definite alcohol intoxication. No life preserver.

11512 MARTIN'S FERRY, cable operated ferry barge, steam, 25.77 gross tons, 60 ft long, steel, 1960, inspection certificate September 9, 1970, master licensed by C.G., operator not licensed. Draft 2'9" fwd, 2'6" aft.

December 18, 1970, 15:15, White River, Norfolk, Arkansas.

Weather - partly cloudy, visibility unlimited, wind S at 10 mph, 40+ F. Water temperature 52 F, strong current 7-8 mph, choppy.

Pickup truck and cement truck crossing on ferry. Ferry started taking water over forward apron on upstream side. Operator asked cement truck driver to back up truck to shift weight. As truck backed up, water began coming over ferry's upstream side, ferry turned, and toppled cement truck into river. Driver got out of cab and surfaced approximately 50 ft downriver from ferry. Life ring buoy was thrown, but swift current carried him out of its reach. His body was recovered 1/2 hour later about 1 mile downstream.

35058 FIVE FORKS, passenger, 78 gross tons, 77 ft lg, 1971, diesel.

February 4, 1972, 05:30, Gulf of Mexico

Weather - clear, visibility 10 mi, wind N, 25-28 mph, seas choppy, 5-6 ft height, water temperature 56°, air temperature 45°.

Man was attempting to transfer from Five Forks to a Mobil Oil drilling rig, Central Facility No. 129. Vessel was rolling approximately 15-25°. He was attempting to use a swing rope and fell into the water. His hands slipped on the rope and he fell part way, and struck a bumper on the stern of the vessel, lost his hold and fell into water. He was thrown a life ring and he manged to hold onto it

and he pulled to the vessel. They were unable to pull the man from the water onto the vessel and subsequent attempts by swimmers to go into the water and retrieve the man were not successful. They attempted to get a life ring around him; however, he disappeared while they attempted to pull him in.

Freighter

26355 PRUDENTIAL SEA JET, a steam propelled freight vessel, and inspected, no details on the vessel.

LIBERTY LAUNCH XLCM, 656 ft. in length with a canopy over the well deck and benches for passengers. At the end of the deck is a small pilot house.

Casualty occurred on March 28, 1972 starting at approx. 2350 while the vessel Sea Jet was at harbor at Vung Tau Roads in S. Vietnam.

The weather was clear, wind was 20 knots, moderate sea and swell, a strong tide in the harbor.

Circumstances were that the Liberty Launch had approached the Sea Jet with crewmen from the dock who were also passengers on the Sea Jet who were preparing to go aboard the launch. There was intended an exchange of crewmen both onboard and off the Sea Jet from the Launch. The Launch was maneuvered near the vessels accomodation ladder and some members of the Launch boarded the Sea Jet ladder with no difficulty, however, as others were about to board the vessel, the Launch motion, by sea action, struck the accommodation ladder and two persons fell into the water from the Launch. Immediately after they fell in the water, ring buoys (a total of 5) were thrown into the water and both persons in the water were seen to be holding onto ring buoys. They were drifting because of the tide motions in the water. The Launch was maneuvered to pick up the two people in the water and the one person was retrieved successfully, however, requiring some time, primarily because of the high freeboard of the Launch and the large physical size of the first man rescued. The Launch then proceeded to rescue the second man, the time now was approximately 0015, however, the second man was found to have drowned and the ring buoy was no longer in his hand. There were no live preservers used. Neither person in the water was observed to be intoxicated.

35463 MAYAGUEZ, freighter, steam, 10485 gross tons, 486 ft, 74 ft beam, 1944, inspected vessel.

September 4, 1972, early morning, vessel underway from San Juan to New Orleans.

Weather - clear, wind 15 kts, visibility 12 mi, air 79 F, seas moderate, 82 F.

Crewmember fell overboard. Was heard to "holler" and other crewmembers heard at approximately 04:15. They dropped ring buoy with light slip, turned and searched, sighted body at 06:30. Lifeboat was lowered and body recovered. No suspected suicide, crewmember was standing by rail, just off duty for air.

35899 CALMAR, freighter, steam, 11,424 gross tons, 500 ft long, 1944, inspected.

November 9, 1972, 14:35, ship underway in Caribbean Sea.

Weather - cloudy, good visibility, wind 20-25 kts, air 83 F, sea 84 F, 8-10 ft swells, 3-5° roll.

Crewman feel from a ladder during ship roll into sea. At 14:35 while ship was underway in Caribbean Sea, and was seen. An alarm was sent at 14:40. Two life rings were thrown about 500 ft from victim. Ship turned and lowered lifeboat; however, victim was lost and apparently lifeboat was not fully launched. Search continued until 18:30 November 10. He was not wearing life preserver.

<u>26054</u> STAGHOUND, freight, 17,902 gross, 12,901 net, 594 x 78.2 x 49-1/2 ft, steam, inspected (container freight vessel with many containers on deck).

February 27, 1972, at ≈ 0918 while vessel underway in North Atlantic (51° 22' N, 30° 07' W)

Weather - stormy, force 10, 40 ft seas, 31° air, 47° water.

Vessel was taking heavy spray over the decks. A crewman was coming off watch and returning on deck to quarters when the sea came aboard (3 to 4 ft on deck) and swept him overboard. He was seen and a life ring and smoke float were released. The vessel turned about to search for the man overboard. A radio alert was sent out on 500 khz. There were no vessels observed within radar range. At 10:55 a drum was sighted that had been released just prior to the man-overboard situation. The search was continued at slow speeds until 11:35 with no success. The crewman who fell overboard was wearing heavy winter clothing - no life preserver - had been directed to go by tunnel from watch station to quarters.

<u>Tankers</u>

<u>25375</u> MILLICOMA, tankship, 10,388 gross, 6,154 net, 523 ft lg, 68' w, steam UNINSPECTED, US NAVY Ship.

At ≈ 6:35 pm crewmember fell overboard while vessel was underway in Lake Melville, Labrador,.

Weather clear, visi good, wind 7-10 knot, 60° air, 58° water, ≈ 1 ft seas.

Vessel was underway at ≈ 14 knots, 2 crewman were in process of securing a section of rail that had been removed for the accommodation ladder when one fell overboard along with a section of rail.

Man overboard alarm was sounded immediately--3 rings were thrown from fantail. Man in water was seen swimming toward life ring (approx. 50 yds).

Vessel was turned & search continued--crewman not sighted again. Man overboard was not wearing a life preserver.

36329

SS ALASKAN, tank vessel, 15,222 gross, 11,026 net, 646 foot x 72 foot steam, inspected.

At ≈ 1420 on 21 April 1973, crewman painting on deck, fell overboard and was lost. No life preserver worn. Weather partly cloudy, good vis., wind 13 to 20 knots, sea 7 to 10 feet, sea temperature 78°. Vessel underway in Atlantic ocean. 32°-03' N, 78°-06'W. Ship rolled, ladder on which crewman was working leaned and crewman fell in in, was seen in water, life ring thrown ≈ 100 feet away from victim. Search pattern started and C. G. Aircraft searched. Body not recovered.

25860 MV KULAND (Panamanian), 28,353 gross tons, 17,545 net, 748' X 102' X 38', tankship, steam.

December 17, 1971, at 7:42 a.m., Chesapeake Bay near Cape Henry Light.

Weather - rainy - wind 10 kts, air 60°

Pilot fell from pilot ladder into water. At 7:00 a.m. pilot ladder was rigged for departure of pilot. At 7:40 pilot started down ladder, slipped, hit launch, fell into water and drowned. Body retrieved by launch soon after in water. Continued to float, but pilot was unconscious from hitting head on launch. Rope pilot ladder apparently slipped downward before pilot fell off.

Barges

16695 WALTER G. HOUGLAND, tug, or towing vessel, 123' length, 28' beam, 345 gross tons, 143 net tons, uninspected, built 1941, probably diesel.

Casualty occurred at about 5:05 a.m. on March 21, 1971 in the Ohio River at mile 897.

Weather - cloudy, light wind, air temperature 34°, water 45°, the river had a current of about 3 mph.

While the towing vessel was exchanging tows with another vessel, one of the crewmen who was assisting in securing the tows slipped and fell between the towing vessel and one of the barges. He was stepping across 3 ft of open water and he seemed to slip and was unable to move either way, and fell in the middle. He was seen to fall, carrying a mooring line. One of the crewmembers pulled back on the mooring line, but he evidently let go of it. After he was in the water he floated downstream slightly and one of the other men was able to get ahold of him with a pike pole hooked to the C.G. approved work vest that he was wearing, and brought him on to the deck of the barge. Total time in the water was estimated at 10 minutes. It was concluded that in attempting to step from the tow to the barge he slipped on ice.

26562 BJ-56, deck barge, 297 tons, 125 x 35 x 8 ft, not propelled, 1971, uninspected.

June 3, 1972 @ 0740 CDT in Bayou Barataria at LaFitte, Louisiana.

Weather - clear, 10 mile visibility, 5 knots wind, 76° air.

Barge was in use in inshore oil exploration and was equipped with quarters for four persons. At the time of casualty, barge was being pushed by tug and proceeding toward moorings at LaFitte. A crewman was standing on top a deck tank assisting in mooring when suddenly he fell overboard. He fell such that his feet struck the top chain rail on the main deck just prior to his going into the water. He surfaced alongside the barge and then disappeared. He was seen to fall. Was not wearing floatation. The C.G. and Police were notified and @ 0928 the body was recovered.

26577 ACBL 2699, barge, 195 x 35 x 10.8 ft, 951 gross tons, freight barge with covered hopper, uninspected.

March 11, 1972, @ ≈ 0840 in the Ohio River at mile 39, near Georgetown, Pennsylvania.

Weather - overcast, good visibility, 32° air, river - high water and strong current, about 40°.

At about 0840 two men were on deck using a "wash-down" hose and one man was seen to fall off the stern end of the barge. The other crewman threw a line that fell short. The man in the water appeared to be trying to stay afloat in the strong current. The man on the barge did not have time to go get a life ring before the man in the water sank. The nearest life ring was about 60 ft from the scene of the casualty. The body was recovered several days later (est ≈ April 22). The man in the water was not wearing a life preserver.

16807 C. W. RUSHING, and tow. C.W. is a diesel tow boat, 106 x 34 x 12', uninspected. Tow consisted of three empty barges.

September 24, 1970, at ≈ 2:55 a.m. CDST, Illinois River, at mile 184.

Weather - overcast, some previous precipitation, decks of vessels were wet, but not slippery. No data on temperatures.

The tug and tow were going downbound and for the purpose of rearranging the tow, were barely moving. The crewmembers were assisting in coupling the barges for the tow, and one of the crewmembers stumbled and fell through the opening between the vessels. He was seen to be in the water and momentarily was using his arms to hold himself up, although he then fell and drifted under the barges. He was wearing a work vest. When he fell through the opening, he momentarily used his arms to hold himself up, but he let go and fell. Efforts were made to locate him in the water but he was not to be found. The tow was moved and the body was then found on the bank about 1/10 mi down river. He was still wearing a work vest.

Fishing Vessels (50 Gross Tons or Over)

25674 HENRY C., shrimp trawler, diesel, 97 gross tons, 65 net, 67 ft long, 22 ft wide, 9.9 ft deep, 1968, uninspected.

July 28, 1971, 23:05, 25 miles ENE of Port Arkansas, Gulf of Mexico.

Weather - fair, wind 1-2 kts, sea calm, temperature 50 F

While vessel was under way, a crewman was attempting to free a net with a pole when he fell overboard. He did not appear to be tangled in the net. Boat was brought around and ring bouy was thrown within 4 ft, but he did not reach for it. Attempt to reach him with a pole failed and he sank. Vessel was equipped with one 6-man raft, four preservers, and two ring bouys--all C.G approved.

25865 WESTERN NO. 5, shrimp trawler, wood, diesel, 67 x 20.5 x 9.5 ft, 99 gross tons, 58 net, 1965.

September 19, 1971, 20:30, Gulf of Mexico.

Weather - winds 20 kts, 6-8 ft sea, visibility 2-3 miles, darkness.

Man fell overboard--line was thrown but man in water could not reach it. Vessel was brought about, but victim disappeared He was not wearing life preserver.

35927 INSHALA, fishing vessel, 103 gross tons, 70 net, 65 ft long, 20 ft wide, diesel, uninspected.

January 10, 1973, 2:45 p.m., 22 miles off Port Mansfield.

There were 3 persons on board. At 2:45 p.m., the boat rolled and a creman went over, holding net, and fell into the water. He was seen and a life ring was thrown to him but it fell short Another ring was thrown, but by this time the victim was tired and could not reach it and sank out of sight. The C.G. was called at 5:32 p.m. and search continued until 7 p.m. Boat was equipped with life preservers, but the victim was not wearing one.

36441 BOBBIE, fishing vessel, 147 gross tons, 82' lg, diesel, 1941, uninspected.

May 30, 1973, 14:30, Princess Royal Channel, British Columbia, Canada, Bering Sea

Weather - clear, wind calm, air 60 F, water 38 F.

Crewman disappeared while vessel was underway across the channel. He was working on deck. Search conducted. Royal Canadian Mounted Police Notified. Charter aircraft also searched.

15080 MISS TRINITY SHOAL, fishing vessel, 72 gross tons, 42 net, diesel, 64.8' X 19.7' X 7.4 ', uninspected.

March 20, 1970, 04:30, Gulf of Mexico, 14 miles NNE of Jeres Light, about 200 miles South of Port Isabel, Texas.

Weather - clear, wind 20-25 kts, visibility 6 miles, seas 4-6 ft, air temperature 60 F, water 65 F.

Vessel was underway, shrimp trawling. There were 3 POB. Crew member was going forward when the sea lifted the stern and he fell overboard. He was seen to fall. Another crewman threw mooring ling, line fell short. The vessel was stopped. Victim was not found in water. He was wearing light clothing and rubber boots, no life preserver. At stern of vessel bulwarks were three feet above deck.

36271 DEBORAH ANN, fishing vessel, 111 gross tons, 75 net, 71 x 22', diesel, 1972, uninspected.

May 4, 1973, 3:00 a.m., 12 miles south of Grand Isla, La.

Weather - clear, visibility unrestricted, wind 15 kts, seas 2-3 ft, choppy.

Crewmember fell into water. Attempts to throw him a line and get him out failed. Another crewmember went into the water with a line. The two were pulled back by another crewman. Waves broke over their heads and both were pulled back to ship, but the first man was slipped from grasp of second man and was lost when they were attempting to board. No life preservers were worn.

Fishing vessel (under 50 gross tons)

26334 L.F. TERRY, fishing vessel, 14 gross tons, 15 net, 41-1/2' x 15-1/2' x 3.7', diesel, 1902, uninspected.

December 8, 1971, 10:45, 150 ft SW of Greenport, Brickwater in Greenport Harbor, L.I.

Weather - visibility 5 mi, wind 8-10 kts, seas rough, 1-2 ft with tide rising.

Vessel underway and a crewman was heading aft along the port side of the main deck at about midships, and the vessel rolled and he apparently slipped and fell into the water. He was able to grab a safety handrail but it gave away. Another crewman saw the accident and called out that a man was overboard. The operator turned and, unfortunately,his arm hit the throttle and the boat stalled and the engine failed to restart. A crewman attempted to throw a rope to the man in the water, but they couldn't reach him and they threw a life preserver. The man grabbed the life preserver and got hold of it. They continued to drift apart and the man in the water was lost to sight from the vessel in about 15-20 minutes. Attempts to restart the engine were in vain. At 10:45 on December 8, the Police Department in the nearby city was notified that a person was overboard calling for help and two small boats in the area responded. They searched the area and could not find the man overboard. The C.G. was notified at 11:50 by the Police Department. At 12:00 the L.F. Terry was towed to the oyster company docks. At 12:28 the body of the man was located and he was dead from drowning.

12468 Unnamed outboard MB AK-2600-C, 35 hp, 16 ft, fiberglass with plywood reinforcing (home built, 1967)

Chiniak Bay, Kodiak Island, Alaska, May 5, 1971, PM.

Weather - overcast, rain fog, visibility variable 1-5 miles, 42F, wind E at 10-15 kts, seas 2 ft E, 43 F.

Owner left to check crabpots at 1400 on May 5. At 20:45 C.G. notified by A.F. that pickup truck and boat trailer were on

beach below high tide. At 21:45 C.G. was notified by wife of owner that her husband was overdue. Ground search commenced that evening. Sea and air search commenced 06:00 on May 6. Owner's capsized boat located at 06:30, stern and outboard motor fouled by crabpot lines. One buoyant vest (C.G. approved) found stowed in bow, another floating in bay. The man's body was located near beach on west shore of Middle Bay. Spongex float marker (6" dia x 16" long) was stuffed up under front of victim's jacket, but he was not wearing an approved life-saving device. Cause of death, exposure and drowning.

25802 TEDDY J, fishing vessel, 40 ft long, 13 ft beam, 25 gross tons, 10 net, wood, 1945.

September 2, 1971, 08:00, vessel underway in Pacific Ocean near San Pedro, California

Weather - overcast, visibility 10 mi, wind 22-30 kts, 8-10 ft sea, water 62 F.

Crewman leaning against a life line (3/16 galvanized wire cable), dipping ocean water with a bucket. Line parted and he fell in. Was seen, vessel backed down. Life preservers thrown. C.G. called. Victim was wearing rubber boots and oilskins. Not recovered.

26258 MERLIN. Fishing vessel, 25 gross tons, 18 net tons, dimensions 52-1/2 x 15.3 x 3.7, diesel powered, uninsp.

Accident occured on Feb. 24 at about 0700 CST in Grand Pass (near Lake Michant), Louisiana.

The circumstances were that the vessel and crew had been fishing and the vessel was anchored and the crew were preparing to get underway for another day of fishing. Two crew members were hauling in the anchor and another one was moving some oyster sacks, when the crew member moving the oyster sacks fell into the water. A line was immediately thrown by other crewmen and also a life jacket; however, the man in the water did not grab either one because of apparently strong current, although the line and the life jacket were thrown close to the man. The second time the line was thrown, the man in the water disappeared and he was not recovered until about 1300. The weather at the time of the casualty was not described.

16870 KING FISHER, fishing vessel,44 gross ton, 16 net, commercial fishing vessel, 54.5' x 15.2' x 6.9', built 1938, uninspected.

December 20, 1970, at ≈ 0930, at Afognak, Alaska.

Weather - overcast, visibility 15 mi, sea calm, winds calm, sea and water 32°.

The circumstances of this casualty is that two persons were on board setting crab pots and one man fell overboard. He was seen to fall, and before they could reach him, he went under the water, and when he surfaced, the other person on board was able to grab him with a pike pole and pull him back on board. The man that fell in the water was wearing heavy quilting and was not wearing a life preserver. Mouth to mouth resuscitation was started, and at 10:20 a message was sent to the C.G. radio station at Kodiak and helicopter pick-up was requested. This was done, but the man was dead on arrival at Kodiak hospital. The man was in the water at an estimated five minutes. Death certificate stated cause of death was drowning and exposure to cold as a result of cold-water immersion. This case illustrates the difficulty of survival in cold water, any immersion at all, that is over the person's head.

26557 SINAJAKA, fishing, 22 gross, 14 net, 48 x 18.6 x 2.7 ft, diesel, built 1961, uninspected.

March 20, 1972 @ 11:00 a crewman fell off the vessel and drowned in the West Perle River 1 mile south ot the Highway 90 Bridge in Louisiana.

Weather - partly cloudy, 8 mph wind, 80° air, river calm, 1 knot current.

Vessel was underway, Captain was forward, crewman aft washing equipment. Captain felt vessel motion, looked back and saw his crewman in the water - his head had just come up. The Captain turned vessel - moved to the stern and threw a plank (the only available flotation device on the stern) but the man went under before the plank reached him. The Captain did not see him resurface. At ≈ 11:10 he notified his employer. C.G. was notified at 11:14. The body was recovered on March 20 ≈ 17:15. This was an oyster vessel - there were no guard rails on stern.

Tugs and towing vessels

15892 BIRMCO, tug, 42.9 x 11 x 4.6 ft, 1915, diesel, uninspected.

September 17, 1970, 10:05 a.m., vessel downbound in St. Clair River.

Weather - wind 10 mph, visibility 7 miles, air temperature 65 F, seas 1 ft, water temperature 62 F.

On the morning of September 17, a crew member went to rail near aft end of vessel with a water pail in his hand. He attempted to scoop up a pail of water, slipped, and fell overboard. In the process, he was not seen to fall, but was seen in the water. He was swimming toward shore. C.G. was notified and dispatched a patrol boat to the scene. A helicopter also joined the search. The search was not successful. Body was recovered on September 18. Victim was not wearing a lifesaving device.

15356 BRENDA H, towing vessel, 99 gross tons, 76.9' lg, diesel, uninspected.

August 6, 1970, 12:00 PDT, El Capitan passage, west coast of Prince of Wales Island, Alaska.

Weather - partly cloudy, 62 F air temperature, wind, sea, and swell were calm, water 48 F.

During late morning hours of August 6, three crew members were preparing a log raft for towing operations and about noon one of the men removed part of his clothing and dove off the raft into the water to retrieve a pike pole that had been dropped and was about 50 ft from the end of the raft. The man got the pole, but then could not make it back and he called for help. Another crew member removed part of his clothing and swam toward the man and a third crew man threw a life ring which was available to the rescuer. Rescuer reached the location of man, but he disappeared beneath surface of the water. The time in the water was estimated to be about 2 minutes (time prior to his disappearance). Other attempts were not successful. Attempts to contact C.G. by radio telephone also were unsuccessful. They were able to reach an air-service radio station and they relayed message to C.G. at Kitchican. Body was located 16:05, August 6. Victim was wearing boots and was not wearing any kind of a flotation device.

26364 ALTON ZEPHYR, towing vessel, 161 gross, 110 net, built 1939. Dimen. 102 x 27 x 6 feet, diesel powered, uninspected.

Casualty occurred on Jan. 5, 1972, at approx. 6 a.m. CST while the towing vessel and 4 barges were proceeding downbound on the Ohio River in the vicinity of Mile 838.

Weather conditions were snow with visib. about 3 miles, wind about 10-15 knots, air temp.1 F.

Circumstances were that at about 1210 a.m. on Jan 5, personnel on the vessel were preparing to retire and the decks of the vessel were reported slippery from the snow. The next morning at 6:00 it was discovered that one of the crew members was missing and a search was conducted. After the search was conducted the vessel started searching the area and the Coast Guard was then notified at approx. 8:25. The man overboard was not recovered. He was not wearing a life saving device. It is presumed that he fell overboard and drowned.

36201 MCALLISTER BROTHERS, towing vessel, 231 gross tons, 157 net, 94' lg, 26' wide, diesel, 1958.

October 9, 1972, 15:40, Upper Bay at New York Harbor, N.Y.

Weather - wind 10-15 kts, visibility 10 mi, air temperature 52 F, sea 2-3 ft.

Crewman fell over the side of towing vessel while tending a pilot ladder in Upper Bay at New York Harbor. He was not seen to fall, but was noticed shortly after in water. He was not wearing a life preserver. He disappeared from view in a short time. Tug attempted rescue, but was unsuccessful. Body was found October 21.

26303 ANNA MARIE. Towing vessel, 121 gross tons, 82 net tons, dimens. 61 x 24 x 7.7. Diesel powered, 1969. Not inspected.

The casualty occurred on Dec. 2, 1971 at approx. 0530 when the vessel was in the Houma Navigation Canal at Cocodrie, Louisiana.

The weather was partly cloudy, slight wind, the air temp. in the low 40's, a current was flowing in the canal, no specific details on the weather.

On the morning of Dec. 2, the push boat or tug boat Anna Marie was attempting to straighten out a tow of barges in the canal. Two crewmen were on the stern of the vessel and getting ready to work with the tow lines when one towline tightened up and caused the one crewman to fall in the water. The other crewman looked overboard,did not see the man overboard on the surface of the water, he then ran forward and notified the Captain that a man had fallen overboard. The crew then launched a flatboat to surface the canal with no results. The sheriff's office was notified at approx. 0540, and the crewman's body was located at about 1400 on 3 Dec. 1971.

The crewman who drowned was not wearing life saving devices at the time of the casualty. There were 3 POB at the time of the casualty.

Platforms and drilling vessels

36366 OCEAN QUEEN, inspected, semi-submersible seagoing drilling barge, 1425 gross tons, 352-1/2 x 217-1/2 z 29 ft depth, 1965, no propulsion.

January 19, 1973, 03:15, Block 133, West Delta Area, Gulf of Mexico.

Weather - dense fog, 50 ft visibility, air temperature 55 F, calm wind, 3-5 kts, 3-4 ft swells.

Workman fell about 50 feet to water and was lost. He was not wearing any life-saving equipment. He was seen to fall, but was not sighted in water. Life preservers were thrown. Brucker capsule lowered, and C.G. called. Search was not successful.

16810 S.S. GROMEIR NORTH SEA, drilling vessel, inspected, 4,255 gross tons, 364' lg, built 1951, inspection certificate expired 1-20-1968.

June 5, 1971, at ≈ 1000, vessel off of Cork, Ireland, anchored and operating in that area (Irish Sea).

Weather - overcast, good visibility, wind force 5, sea 10-12 ft, vessel rolled max. 2°, pitch 1/2°.

The men were working on the drilling rig, joining some of the pipe sections in the main drill stream when an accident occurred which allowed the two men to fall from a platform. The two men on the bridge had been standing, apparently, on a section of pipe called the blowout, and this pipe was being held up by another piece of pipe and the problem was that the joint between them gave way, and allowed the pipe to fall into the ocean. The two personnel went down with the section of pipe and one came to the surface and one did not. The one that came to the surface was retrieved by means of another man going down to the water level and diving in and rescuing him. The other man never surfaced. Neither one were wearing any type of lifesaving equipment. There is no information in report as to how far the men fell before they hit the water. The man who was saved said he went under water for quite a distance before he came back up. The location of the men was above the main deck of the drilling rig. The man said he struck his head on the bottom of the moon pool and was dazed and weak as a result of that.

16830 Humble Platform #L , Grand Isle Block #16, Gulf of Mexico.

January 26, 1971 at ≈ 9:50.

Platform L is a fixed platform used as collection point for the transmission of gas products ashore. The circumstances were that a workman was working on a pipe connection on a platform about 40' above the water level when the pipe line was inadvertently pressurized with high pressure gas. The high-pressure gas came from the glycol stack. It knocked the workman through the guard railing and into the water 40' below. He was observed by the crew to remain floating in the water for approximately 30 seconds before sinking. Divers recovered body from 60' of water at approximately 1550 on that day. Accident occurred ≈ 0950. He was not wearing life preserver. Area was well protected by guard rails.

He was blown right through the guard rails. Report lists he suffered death by drowning, but he also suffered injuries when he was blown through the railing. Another report says the high pressure was a gas line without defining what kind of gas.

16755 THE SPIRIT OF WEBB, rig #8, inland marsh-area drill rig, 10,050 gross tons, 164 x 54 x 12 ft depth, uninspected.

June 30, 1970, 14:00, Lay-up status, rig moored at Diamond Construction Yard at Bayou Rouef, Louisiana.

Weather - fair, light winds, not much current in Bayou.

At about 14:00 one man was painting the pipe and chainlink fence around the heliport railing. This is about 60 ft above the water level. Shortly thereafter he was found to be missing from doing his work, and a search was commenced and the Sherriff's department was notified. At about 16:55, his body was found by dragging and recovered from 10 to 12 ft deep water under the section where he had been working. The death certificate indicated that he died from drowning. There was no evidence of any severe physical damage.

26246 Fixed Platform No-A13, a moveable offshore rig. Platform is a fixed manned artificial island with 2 decks mounted on 8 legs that are fixed to sea bottom. Upper deck 90 ft above water and lower deck 15 ft below the main deck. Platform is equipped with boat dock which is connected to main deck by a steel ladder. Boat dock is approximately 4 x 16-ft steel grating lined with rubber tires at about 8 ft above water.

January 25, 1972, 10:45, Block 293 of main pass Outer Continental Shelf, Gulf of Mexico.

Weather - overcast, visibility 5-10 miles, winds gusty, 20-25 kts, seas 6-8 ft with swells 12 ft.

At approximately 10:45 crewmembers were directed to go below and connect the water hoses from boat. They put on C.G. approved work vests and went down the ladder to the boat dock. A freight vessel was on the leaward side of the boat dock approximately 75-ft away, and they passed the line to the workmen for connecting a water hose to the

boat dock manifold. At approximately 11:00, after the hose connections were completed, a large wave, approximately 12-ft high swept the boat dock area and both men were washed off. One man was able to grasp the rope connecting to the main deck but the other was washed into the sea. The man who was successful in getting back to the boat dock threw a line to the man in the water, and he grasped it and was being pulled back toward the boat dock. However, when he got close to the boat dock, he was unable to hold on any longer and he let go of the line. A helicopter was used to drop another man into the water close to the boat that was moored to the platform. Unfortunately, the one man that had been in the water longest was drowned. He was wearing a life vest (work vest); however, it was found that he had some physical injury including four broken ribs when he was swept off the boat dock.

Miscellaneous

26259 EAGLE. Work boat of 148 gross tons, 52 net tons, dimens. 93 x 23 x 9, diesel powered boat #1925, uninsp.

The casualty occured at approx. 1120 on Feb. 4, 1972, at the Humble Oil docks in Bayou Rigou, Grand Isle, Lousiana.

The weather was clear with 10 mi. visib. wind was 20 knots, 44 F air temp., 37 F. water. Seas were calm.

The casualty events were that the crew members were working on board the vessel on some engine parts, one crew member leaned over the end rail and his feet slipped and he lost his balance and fell between the vessel and the dock. Another crew member attempted to reach him after he fell overboard but he was unsuccessful because the person in the water did not come back to the surface. The Coast Guard was notified and the Sheriffs office was notified. The body was recovered at approx. 1230 on Feb. 4. The victim was not wearing the floatation equipment when he fell into the water.

16580 THE SCOW #137, American Drenching Company, 188 x 43 x 60'. dredging Scow was under tow by tug DRANK H. CAVEN, 125 gross tons, 83.4 x 22.5 x 8.2', diesel powered. Neither vessel inspected.

June 23, 1970, 10:30 p.m. while tug and scow were approaching another dredge in the vicinity of Buoy 4-A, Newark Bay, New Jersey.

Weather - 1-3 kt wind, visibility 5 mi, scattered clouds, air temperature 70 F, and flood tide was in progress.

As vessel was approaching the dredge to exchange gun scows, one of the crewmen of the Scow fell overboard. This was at about 10:30 p.m. EST. It was dark. He was seen to fall, and the tug and its tow were cast off so that they would separate from the other dredge. While they were casting off, the Captain reported to other tugs that he had a man overboard. Other tugs began searching the area up stream of the dredge and about five minutes after the man fell overboard he was sighted and a tug maneuvered to pick him up. After he was picked up he was given artificial respiration; however, he died. The man who sent overboard was wearing a C.G. approved work vest. The cause of the death was drowning, but there was some evidence of injury as he fell.

25807 DOLPHIN, cannery tender (freight), 123 gross, 102 net, 1945, wood, 76 ft long, 24 ft wide, 6 ft deep.

At 1:30 am on 20 July 1971, crewman slipped while stepping from cannery tender to fishing vessel. Fell into water & drowned.

Weather cloudy, rain, visi 7 mi, 10 knot wind, 46° air, water ≈ 39°.

5 POB, one person fell on leaving the tender to return to his ship. Was heard to yell. (1) lifeline, (1) life jacket were thrown to him. Was being swept away by tidal current. Several vessels searched area. At 6:00 pm 20 July body was found. Was not wearing floatation.

36303 Work flat, pontoon type, 20 x 20 x 3'

February 5, 1973, 6:30 p.m. CST, while work flat was moored at Mile 201 of Upper Missippi River.

Weather - cold water 34 F.

While work flat was moored, a crewman fell overboard and was heard to yell for help. Another worker was unable to reach him. Coast Guard and others called to help. Body recovered on February 7. He was not wearing any life-saving equipment.

11635 Unnamed work rowboat from fishing vessel Sea Hawk, 6 ft.

August 12, 1970, 04:00 PDT, San Luis Obispo Bay, California

Weather - foggy, wind 5 kts, 70 F, sea calm 68 F, tide flooding.

A man rowed load of supplies to Sea Hawk and put supplies aboard. Later, work boat was observed capsized. Body of man was found floating face down at approximately 07:00. It was presumed that he fell into the water while transferring supplies and struck his head. Death was due to drowning. He was not wearing a life preserver.

26111 BT-37, crane barge, 300 gross, 135' lg, 35'w x 8' deep, uninspected.

Feburary 1, 1972, @ ≈ 1345 in West Galveston Bay (anchored)

Weather - cloudy, visibility 6-8 miles, wind 10 knots, 47° air, 55° water, seas choppy, 1-2 ft.

The barge was ≈ 1000 yds offshore and the crew of six returned to the barge after lunch. While the crewmen were working on deck with pipe and cables, one crewmember slipped and fell overboard. The man over was in panic and splashing. A life preserver was thrown to him but he did not grab it and he shortly sank. A life ring was available aboard the barge, but it was not thrown. Two other persons dove into the water to look for the victim without success. The outboard motorboat aboard the barge was then sent ashore to call the C.G. and the Sheriff. The body was located by dragging operations at about 1530 after the victim had been in the water about one hour and 45 minutes.

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES

VESSEL IDENTIFICATION	MONTH DAY YEAR DATE	LOCATION	WIND SPEED	WAVE HEIGHT	AIR TEMPERATURE	WATER TEMPERATURE	VISIBILITY	CASUALTY TYPE	NOTES
CARRY BACK & CHAMBERS AND KENNEDY PLATFORM (PASSENGER/FREIGHT)	6/10/70	GULF OF MEXICO	14 MPH	3 FT.	80F	---	CLEAR (DAY)	FIRE ON PLATFORM & SHIP	CARRYBACK - 136 GROSS TONS, UNINSPECTED PASSENGER/FREIGHT, MOORED TO PLATFORM LIFE PRES. & RINGS THROWN - NOT WORN
ALCOA CORSAIR (8481 GROSS) LORENZO MARCELLO (PASSENGER/FREIGHT)	8/22/60	LOWER MISS. RIVER	0	--	--	--	CLEAR (NIGHT)	COLLISION	ALCOA CORSAIR GROUNDED (INTENTIONAL) INJURED REMOVED BY LIFEBOAT NO ABANDONMENT FROM LORENZO MARCELLO
YARMOUTH CASTLE (PANAMANIAN) (5002 GROSS) (PASSENGER)	11/13/65	ATLANTIC	4 TO 7 MPH	SMOOTH	80F	--	CLEAR (NIGHT)	FIRE & SINKING	2 OTHER VESSELS IN RESCUE EFFORT 16 LIFEBOATS FROM OTHER VESSELS - SHUTTLED
HANSEATIC (30,030 GROSS) (GERMAN) (PASSENGER)	9/7/66	NEW YORK PIER	--	--	--	--	CLEAR (DAY)	FIRE	SHIPS FIRE EQPT. NOT EFFECTIVE - WAS USED FIRE EXT. USING WATER & FOAM - 3 FIREBOATS PLUS SHORE UNITS
THORSTREAM (5,754 GROSS) (NORWAY) (FREIGHT)	6/2/67	BUFFALO PIER	--	--	63F	--	CLEAR (DAY)	FIRE	SHIPS HOSES USED - FIRE EXTING. BY FIRE DEPT. - 38 MIN. 4 POB KILLED IN FIRE.
MARINE MERCHANT (6,639 GROSS) (INSPECTED) (FREIGHT)	4/14/61	GULF OF MAINE	55-65 MPH	20 FT.	38F	42F	RAIN SNOW FOG	SINKING	CONFUSED SEA, LIFE NET USED TO BOARD LIFE BOAT. ABANDONMENT STARTED 0430
PANOCEANIC FAITH (8157 GROSS) (INSPECTED) (FREIGHT)	10/9/67	NORTH PACIFIC	40-45 MPH	20-25 FT.	48F	50F	3-6 MI. RAIN DAY & NIGHT	SINKING	ONE LIFEBOAT UNUSEABLE DUE TO WEATHER ONE LIFEBOAT FELL DURING LAUNCH AIRCRAFT DROPPED RAFTS, LIGHTS, SMOKE
STEEL VENDOR (7752 GROSS) (INSPECTED) (FREIGHT)	10/7/71	SOUTH CHINA SEA	≈ 50 MPH	HEAVY EST. 20 FT.	--	--	-- DAY	STRANDED ON REEF (LOST)	TROPICAL STORM ELAINE, ROLLING 35-40° BROKE UP ON REEF - COMMUNICATION MAINTAINED DURING ABANDONMENT
UNION FAITH (7301 GROSS) * WARREN J. DOUCET & TOW	4/6/69	LOWER MISS. RIVER	7 MPH	--	66F	--	10 MILES (NIGHT)	COLLISION & FIRE	UNION FAITH - TAIWAN - SURVIVORS RESCUED BY TUGS ON SCENE FROM WATER - NO LIFE PRESERVER USE RECORDED

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	COMMUNICATIONS BEFORE ABANDONMENT	COMMUNICATIONS AFTER ABANDONMENT	TIME FOR SINKING	TIME FOR SAR ARRIVAL	PERSONS ON BOARD	PERSONS ABANDONING BY LIFE BOAT	PERSONS ABANDONING BY LIFE RAFT	PERSONS ABANDONING BY JUMPING	PERSONS ABANDONING BY OTHER MEANS	PERSONS SAVED FROM LIFE BOAT	PERSONS SAVED FROM LIFE RAFT	PERSONS SAVED FROM WATER	PERSONS SAVED - TOTAL	NOTES
CARRY BACK & CHAMBERS AND KENNEDY PLATFORM	NONE	BY SMALL CRAFT NEARBY	---	UNK. EST. 15 MIN.	4 (SHIP) 22 (PL.)	0	0	21	0	0	0	17	17	4 ON SHIP DIED IN FIRE 1 ON PL.
ALCOA CORSAIR & LORENZO MARCELLO	WHISTLE	C.G. BY OTHER VESSELS	---	UNK. (SHORT)	150 (CORSAIR) (51 PASS.)	EST. 15	0	0	125 (TRANSF.)	EST. 15	0	0	140	5 CREW 5 PASS KILLED ON BOARD
YARMOUTH CASTLE (PANAMANIAN)	NONE	FLARES (LIFE BOAT)	4 1/2 HR.	1 HR.	552 (376 PASS.)	6 BOATS	0	SEVERAL SWAM TO LIFE BOAT	16 BOATS	EST. 150	0	SEVERAL TO LIFE BOAT	462	16 BOATS FROM OTHER VESSELS
HANSEATIC	N.Y. FIRE DEPT. CALLED	---	---	SHORT (FIRE DEPT.)	UNK.	--	--	--	--	--	--	--	ALL	NO ABANDON. 7 HR. FIRE
THORSTREAM	FIRE DEPT CALLED	---	--	SHORT (FIR	UNK	--	--	--	--	--	--	--	--	NO ALARM SIGNAL ON VESSEL
MARINE MERCHANT	SOS	--	4 1/2 HR.	6 HRS	35	35	0	0	0	35	0	0	35	2 LIFEBOATS LIFE PRES. USED
PANOCEANIC FAITH	SOS	FLASHLIGHT (1 MAN)	50 MIN.	18 HRS (SHIP)	41	20 TO 25	0	16 TO 21	0	0	3 ALIVE 4 DEAD	2	5	2 IN WATER ON DEBRIS L.P. USED
STEEL VENDOR	SOS	--	--	6 HRS	UNK.	---	---	---	UNK. HELI.	---	---	---	ALL UNK. NUMBER	HELICOPTER, BRITISH AIR-CRAFT CARRIER
UNION FAITH	NONE	---	6 3/4 HR.	ON SCENE	51	0	0	26	0	0	0	26	26	COLLISION SEEN OTHER VESSELS

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	DATE MONTH DAY YEAR	LOCATION	WIND SPEED	WAVE HEIGHT	AIR TEMPERATURE	WATER TEMPERATURE	VISIBILITY	CASUALTY TYPE	NOTES
BADGER STATE (8166 GROSS) (INSPECTED) (FREIGHT)	12/26/69	PACIFIC OCEAN	46-58 MPH	30-40 FT.	49 F	56 F	6 MILES (NIGHT)	SINKING	2 LIFE RAFTS LAUNCHED & LOST, 1 L.B. LOST, 1 LIFEBOAT LAUNCHED WITH 35 PERSONS - HIT BY FALLING CARGO & CAPSIZED.
UNION RELIANCE (7639 GROSS) (CHINESE) (FREIGHT)	11/7/61	HOUSTON SHIP CHANNEL	13-18 MPH	SLIGHT	58 F	--	GOOD (NIGHT)	COLLISION & FIRE	FIRE STARTED FROM BEREAN & SPREAD. FIRE HOSES INADEQUATE FIRE BURNED OUT - SEVERAL DAYS
BEREAN (9003) (NORWAY) (TANKER)	"	"	"	"	"	"	"	"	FIRE OUT IN ABOUT 4½ HRS.
ARIZONA & MEIKO MARU (FREIGHT) (TANKER) (12711 GROSS) (995 GROSS)	8/2/73	PACIFIC	LIGHT	SMOOTH	--	--	FOG (NIGHT)	COLLISION MEIKO SANK	MEIKO MARU CUT IN TWO -
TEXACO OKLAHOMA (20,084 GROSS) (INSPECTED) (TANKER)	3/27/71	ATLANTIC OFF HATTERAS	69-75 MPH	30-40 FT.	55F	74F	(NIGHT)	BREAK-UP SANK	ATTEMPTS TO ATTRACT ATTEN. UNSUCCESSFUL 2 PERSONS IN WATER 33 HRS
SANTA MARIA & SIRRAH (11,291 GROSS) (12 463) (TANKER) (TANKER)	10/19/64	KNICK ARM ALASKA	23 MPH	CALM	--	COLD	10 MILES (DAY)	COLLISION FIRE	SIRRAH (DUTCH) WAS ANCHORED. FIRE ON SANTA MARIA UNCONTROLLABLE - VESSEL GROUNDED, BURNED OUT, LATER FLOATED FREE
SAN JACINTO (INSPECTED) (11,257 GROSS) (TANKER)	3/25/64	ATLANTIC OFF VIRGINIA	--	--	--	--	--	EXPLOSION BREAK-UP 2 SECTION	LIFEBOAT FROM FWD. TRANSFERRED POB FWD TO STERN - BOTH SECTIONS TOWED TO PORT. 2 POB TRANSF. TO OTHER VESSEL
GEORGE MACDONALD (10,164 GROSS) (TANKER) (INSPECTED)	6/30/60	ATLANTIC OFF GEORGIA	12-20 MPH	--	--	--	CLEAR DAY & NIGHT	FOUNDER & SINKING	ATTEMPTS WERE MADE TO TOW VESSEL POB TRANSFER BY LIFEBOAT OVER 19½ HR PERIOD.
BUNKER HILL (10,590 GROSS) (TANKER) (INSPECTED	3/6/64	PACIFIC ROSARIO STRAIT	6 MPH	CALM	--	--	10 MILES (NIGHT)	EXPLOSION BREAK-UP SINKING	LIFEBOAT SWAMPED DURING LAUNCHING POB IN WATER - DETAILS CONFLICTING

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	COMMUNICATIONS BEFORE ABANDONMENT	COMMUNICATIONS AFTER ABANDONMENT	TIME FOR SINKING	TIME FOR SAR ARRIVAL	PERSONS ON BOARD	PERSONS ABANDONING BY LIFE BOAT	PERSONS ABANDONING BY LIFE RAFT	PERSONS ABANDONING BY JUMPING	PERSONS ABANDONING BY OTHER MEANS	PERSONS SAVED FROM LIFE BOAT	PERSONS SAVED FROM LIFE RAFT	PERSONS SAVED FROM WATER	PERSONS SAVED - TOTAL	NOTES
BADGER STATE	RADIO & VISUAL	---	10 DAYS	1 HR.	40	3	0	5	0	0	0	14	14	L.P. USED
UNION RELIANCE	WHISTLE VISUAL	---	--	--	36	23	0	6	0	24	0	1 INTO LIFE BOAT	24	WOOD L.B.s AFIRE
BEREAN	WHISTLE VISUAL	---	--	1¼ HR	UNK	ALL BUT 16	0	0	0	UNK	0	0	ALL	FIRE OUT IN 5¼ HRS
ARIZONA & MEIKO MARU (FREIGHT) (TANKER)	NONE	--	SHORT	10 HR. (MEIKO)	19 (MEIKO)	--	--	--	--	--	--	1	1	
TEXACO OKLAHOMA	RADIO TRIED	FLARES SMOKE LIGHT	27 HR	11 HR	44	0	15	--	--	0	11	2	13	31 WITH L.P.
SANTA MARIA & SIRRAH	WHISTLE	VISUAL	--	ON SCENE	39 (MARIA)	7	0	1	31 (TUG)	7	0	0	38	
SAN JACINTO	NONE	(FWD SECT) VISUAL	DID NOT SINK	SHORT TIME	37	UNK EST. 8	0	0	0	UNK EST. 8	0	0	37	1 POB DIED OF HEART ATTACK
GEORGE MACDONALD	RADIO	VISUAL & RADIO	52 HR.	UNK. EST. 2 HR.	42	42	0	0	0	42	0	0	42	L.P. USED
BUNKER HILL	NONE	NONE	LESS THAN 1 HR	LESS THAN 1 HR	31	L.B. LAUNCH SWAMP	0	18	0	22	0	4 (HELI)	26	EXPL. SEEN ON SHORE

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	DATE MONTH DAY YEAR	LOCATION	WIND SPEED	WAVE HEIGHT	AIR TEMPERATURE	WATER TEMPERATURE	VISIBILITY	CASUALTY TYPE	NOTES
TEXACO MASSACHUSETTS (16,515 GROSS) (TANKER) INSPECTED	6/16/66	NEWARK BAY	17-23 MPH	CALM	76F	65F	CLEAR (DAY)	COLLISION & FIRE	1 FIBERGLASS L.B. BURNED
ALVA CAPE (BRITISH) (11,252 GROSS) (TANKER)	"	"	"	"	"	"	"	COLLISION FIRE GROUNDING	STEAM SMOTHERING & OTHER F.F. EQPT USED LIFEBOATS (ALUM.) - DESTR. BY FIRE
ESSO VERMONT (197 GROSS) (TUG)	"	"	"	"	"	"	"	FIRE	CO_2 SYSTEM INOPERATIVE, TOWED & GROUNDED,
LATIN AMERICA (165 GROSS) (TUG)	"	"	"	"	"	"	"	FIRE	TUG ENGULFED BY NAPTHA VAPOR - FIRE & EXPL. LIFEBOAT (ALUM.) DESTROYED
AMOCO VIRGINIA (12527 GROSS) (TANKER) (INSPECTED)	11/8/59	HOUSTON SHIP CHANNEL	LIGHT	--	--	--	CLEAR (NIGHT)	EXPLOSION & FIRE	MOORED AT DOCK - MOST OF CREW ABANDONED BY GANGWAY & MOORING LINES SHIPS F.F. EQPT. NOT USED - OTHER FF EQPT. USED.
SULPHUR QUEEN (7,240 GROSS) (TANKER) (INSPECTED)	2/4/63 (APPROX.)	STRAITS OF FLORIDA	29-53 MPH	16 FT.	--	--	--	DISAPPEAR.	LIFE PRESERVER, FOGHORN, & DEBRIS FOUND NO TRACE OF PERSONNEL
BOHEME & PARKER (3,747 GROSS) (1576 GROSS) (NORWAY TANKER) (TANK BARGE)	10/20/62	LOWER MISS. RIVER	LIGHT	--	--	--	1½-2 MILES HAZE	COLLISION & FIRE	FIRE ON TANKER - GROUNDED - FIRE CONT'D. 0340 TO 2400, BARGE UNINSPECTED
OLYMPIC ROCK & PRINCESS (13,665 GROSS) (91 GROSS) (LIBERIAN TANK.) (TUG)	2/21/62	DELAWARE RIVER	NONE	NONE	UNK	UNK	1-2 MI. SNOW	COLLISION TUG SANK	TUG & TOW, TUG CAPSIZED & SANK QUICKLY, MAST ABOVE WATER. LIFE RAFT INFLATED AUTOMATICALLY
SOUTHERN CITIES (55 GROSS) (TUG) (UNINSPECTED)	11/1/66	GULF OF MEXICO	35-46 MPH	9-13 FT.	--	--	--	DISAPPEAR.	BARGE IN TOW - FOUND TUG LOST - NO TRACE

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	COMMUNICATIONS BEFORE ABANDONMENT	COMMUNICATIONS AFTER ABANDONMENT	TIME FOR SINKING	TIME FOR SAR ARRIVAL	PERSONS ON BOARD	PERSONS ABANDONING BY LIFE BOAT	PERSONS ABANDONING BY LIFE RAFT	PERSONS ABANDONING BY JUMPING	PERSONS ABANDONING BY OTHER MEANS	PERSONS SAVED FROM LIFE BOAT	PERSONS SAVED FROM LIFE RAFT	PERSONS SAVED FROM WATER	PERSONS SAVED - TOTAL	NOTES
TEXACO MASSACHUSETTS	GEN. ALARM	VISUAL	--	ON SCENE	UNK.	0	0	MOST OF CREW	4 (HELI.)	0	0	UNK.	UNK.	3 LOST.
ALVA CAPE	PILOT'S RADIO	VISUAL	4½ HR.	ON SCENE	UNK.	0	0	MOST OF CREW	0	0	0	UNK.	UNK.	19 LOST
ESSO VERMONT	--	VISUAL	---	ON SCENE	8 EST	0	0	--	0	0	0	0	0	CREW DIED IN FIRE (EST. 8)
LATIN AMERICA	--	VISUAL	--	ON SCENE	UNK.	0	0	CREW	0	0	0	UNK	UNK.	3 LOST
AMOCO VIRGINIA	VISUAL	VISUAL	--	SHORT TIME (EST. ½ HR.)	UNK	0	0	2	UNK	0	0	2	UNK.	6 LOST IN FIRE -
SULPHUR QUEEN	NONE	NONE	UNK.	--	39	--	--	--	--	0	0	0	0	TOTAL LOSS
BOHEME & PARKER	GEN. ALARM (BOTH)	VISUAL	--	½ HR EST.	48 (BOHEME)	MANY	0	SOME	0	MANY	0	SOME	28	20 LOST ON TANKER
OLYMPIC ROCK & PRINCESS	VISUAL	VISUAL	IMMED.		5 (TUG)	0	0	5	0	0	1	1 (RING)	2	OLYMPIC THREW RINGS
SOUTHERN CITIES	NONE	NONE	--	--	6	--	--	--	--	0	0	0	0	TOTAL LOSS

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	DATE MONTH DAY YEAR	LOCATION	WIND SPEED	WAVE HEIGHT	AIR TEMPERATURE	WATER TEMPERATURE	VISIBILITY	CASUALTY TYPE	NOTES
MAJORIE McALLISTER (198 GROSS) (TUG) (UNINSPECTED)	11/2/69	ATLANTIC OFF N. CAROLINA	56-69 MPH.	30 FT	--	--	RAIN	DISAPPEAR.	LIFERAFT & RING BUOY FOUND NO TRACE OF PERSONNEL
THERESA F (197 GROSS) (TUG) (UNINSPECTED)	1/9/69	GULF OF MEXICO	23-35 MPH	4-5 FT.	--	--	10 MILE CLEAR (NIGHT)	CAPSIZED & SANK	TUG WAS TOWING BARGE. CAPSIZED TUG SEEN BY PILOT BOAT. SANK LATER
INTREPID (199 GROSS) (TUG) (UNINSPECTED)	2/19/70	GULF OF ALASKA	57 MPH	20 FT	LOW	50F	5 MILE (NIGHT)	CAPSIZED & SANK	APPROX 63 HRS IN RAFTS, 1 MAN IN 1 RAFT DIED. BUSH PILOT SAW BARGE - SEARCH INITIATED
PHILIP ARTHUR (48 GROSS) (TUG) (UNINSPECTED)	12/31/60	PORT ARTHUR CANAL	--	--	--	--	CLEAR (NIGHT)	SINKING	SUSPECTED BARGE OVERRUN - BRIDGE TENDER SAW BARGE HEARD CREW.
ARIZONA SWORD (3161 GROSS) (BARGE) (INSPECTED)	1/13/61	ATLANTIC OFF FLORIDA	20-30 MPH.	5-6 FT.	--	--	(NIGHT)	SINKING	INSPECTED BARGE IN TOW
FENWICK ISLAND (199 GROSS) (FISHING) (UNINSPECTED)	12/7/68	ATLANTIC OFF HATTERAS	70-80 MPH	20 FT.	40F	60F	3 MILE (NIGHT)	CAPSIZED & SANK	RESCUE BY ANOTHER FISHING VESSEL 2 SEINE BOATS ON BOARD NOT USED
TWO GEORGES (11 GROSS) (PARTY FISH.) (INSPECTED)	3/25/64	SOUTH LAKE WORTH INLET	19-24 MPH	4-6 FT.	--	--	GOOD	CAPSIZED	WAVES UP TO 15 FT. - LARGE STERN WAVE SWAMPED & CAPSIZED VESSEL
TRIPLE CROWN (288 GROSS) (SUPPLY VESSEL) (UNINSPECTED)	11/25/68	SANTA BARBARA CHANNEL	35 MPH	5 FT 10 FT SWELL	60F	57F	GOOD (NIGHT)	CAPSIZED & SANK	VESSEL FLOODED 30-45 MIN. RETRIEVAL
WHITE ALDER & HELENA (132 GROSS) (7648 GROSS) (BUOY TENDER) (TAIWAN)	12/7/68	MISS. RIVER	20 MPH	--	45F	52F	CLEAR (NIGHT)	COLLISION & SINKING	WHITE ALDER SANK - CREW SWAM TO BUOY HELENA ATTEMPTED SMALL CRAFT LAUNCH - UNUSED 30 MIN. RETRIEVAL BY SMALL CRAFT

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	COMMUNICATIONS BEFORE ABANDONMENT	COMMUNICATIONS AFTER ABANDONMENT	TIME FOR SINKING	TIME FOR SAR ARRIVAL	PERSONS ON BOARD	PERSONS ABANDONING BY LIFE BOAT	PERSONS ABANDONING BY LIFE RAFT	PERSONS ABANDONING BY JUMPING	PERSONS ABANDONING BY OTHER MEANS	PERSONS SAVED FROM LIFE BOAT	PERSONS SAVED FROM RAFT	PERSONS SAVED FROM WATER	PERSONS SAVED - TOTAL	NOTES
MAJORIE McALLISTER	RADIO DISTRESS CALL	NONE	UNK.	2 HR	6	--	--	--	--	0	0	0	0	SAR DID NOT FIND VESSEL
THERESA F.	NONE (POWER LOST)	FLARES & LIGHT	CAPSIZE IMMED.	SHORT	10	0	7 (WATER)	1 (WITH L.P.)	--	--	7	0	7	RAFT INFL. - CREW IN WATER TO RAFT
INTREPID	NONE	NONE	10-15 MIN.	APPROX. 60 HRS.	8	0	6 (WATER)	--	--	0	5	0	5	2 RAFTS TIED LATER SEP.
PHILIP ARTHUR	NONE	VOICE	IMMED.	15 MIN.	6	0	0	3 EST.	0	0	0	0	0	
ARIZONA SWORD	NONE	VOICE	1 MIN.	ON SCENE	8	0	0	1	0	0	0	1 (2 HRS.)	1	1 PERSON PICKED UP BY TUG
FENWICK ISLAND	RADIO DISTRESS CALL	NONE	APPROX. 30 MIN.	APPROX. 1 HR.	14	0	0	14	0	0	0	7	7	CREW WITH L.P.
TWO GEORGES	NONE	SEEN BY OTHER VESSELS	CAPSIZE IMMED.	ON SCENE	20	0	0	20	0	0	0	15 (45 MIN.)	15	POB NOT WEARING L.P.
TRIPLE CROWN	RADIO DISTRESS CALL	SEEN BY OTHER VESSEL	3-5 MIN.	ON SCENE	25	0	0	18	0	0	1	15	16	L. RINGS & DEBRIS & L.P. USED
WHITE ALDER & HELENA	SIGNAL BY HELENA	OTHER VESSEL	IMMED.	30 MIN.	20	0	0	20	0	0	0	3	3	3 HOLDING TO BUOY. NO L.P. ON.

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	DATE MONTH DAY YEAR	LOCATION	WIND SPEED	WAVE HEIGHT	AIR TEMPERATURE	WATER TEMPERATURE	VISIBILITY	CASUALTY TYPE	NOTES
RELIEF & GREEN BAY (6,125 GROSS) (LIGHTSHIP) (FREIGHT)	6/24/60	AMBROSE STATION N.J.	LIGHT	CALM	--	--	ZERO DENSE FOG	COLLISION & SINKING	RELIEF SANK - SMALL BOAT FROM GREEN BAY PICKED UP SURVIVORS
S-21 (3549 GROSS) (INSPECTED) (DRILL RIG TENDER)	9/21/60	GULF OF MEXICO	--	--	--	--	--	EXPLOSION & FIRE	DID NOT ABANDON SHIP - 1 MAN JUMPED & WAS RETRIEVED BY RAFT - FIRE UNDER CONTROL APPROX. 2 HR.
43-A (CONTINENTAL) (OIL PLATFORM)	10/24/67	GULF OF MEXICO	5-8 MPH	2 FT.	--	--	CLEAR	EXPLOSION & FIRE	CREW BOAT SAW FIRE & PICKED UP SURVIVORS
JULIE ANN (DIXILYN 8) (OIL DRILL. PLATFORM)	3/13/68	GULF OF MEXICO	57 MPH	20 Ft.	--	--	(DAY) POOR (RAIN)	BREAK-UP & SINKING	FLOATING VESSEL WITH LEGS

TABLE A 1.5. TABULAR SUMMARY OF CASUALTY REVIEW BOARD CASES
(Continued)

VESSEL IDENTIFICATION	COMMUNICATIONS BEFORE ABANDONMENT	COMMUNICATIONS AFTER ABANDONMENT	TIME FOR SINKING	TIME FOR SAR ARRIVAL	PERSONS ON BOARD	PERSONS ABANDONING BY LIFE BOAT	PERSONS ABANDONING BY LIFE RAFT	PERSONS ABANDONING BY JUMPING	PERSONS ABANDONING BY OTHER MEANS	PERSONS SAVED FROM LIFE BOAT	PERSONS SAVED FROM LIFE RAFT	PERSONS SAVED FROM WATER	PERSONS SAVED - TOTAL	NOTES
RELIEF & GREEN BAY	SIREN ALARM	FLARES WHISTLES	7 MIN. EST.	ON SCENE	UNK.	0	UNK.	0	0	0	UNK.	0	UNK.	1¼ HR. RETR.
S-21	- -	- -	NONE	NONE	54	0	0	1 (RETR. ABOARD)	0	0	0	0	54	
43-A	NONE	NONE	- -	10 MIN. EST.	8	0	0	2 (55 FT)	6 (LADDERS)	0	0	8	8	6 W. L. P. a.
JULIE ANN	RADIO NOTIFIC.	VISUAL RADIO	15 HRS.	ON SCENE	29	0	0	0	NOTE	0	0	0	29	9 BY SUPPLY VES. 20 BY HELI. (4 HRS)

APPENDIX B

BRIEF STATEMENTS AND BIBLIOGRAPHIC INFORMATION

APPENDIX B

B1.0 BRIEF STATEMENTS AND BIBLIOGRAPHIC INFORMATION

B1.1 Life Boats

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